

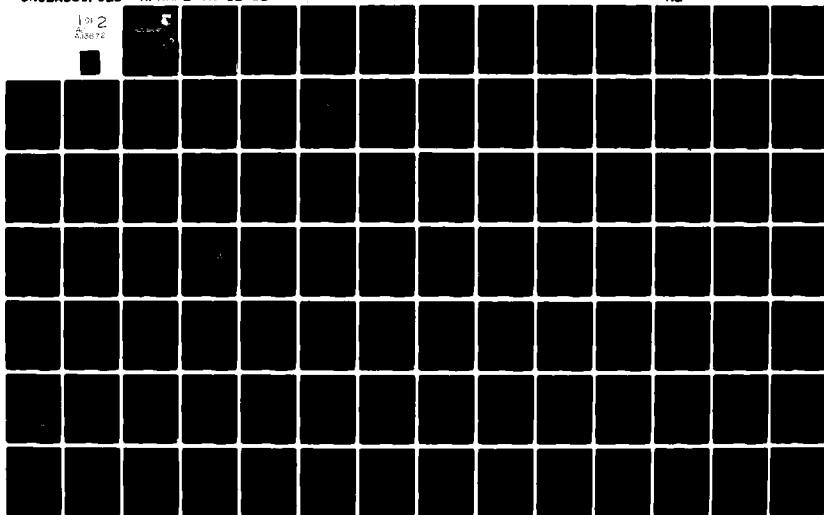
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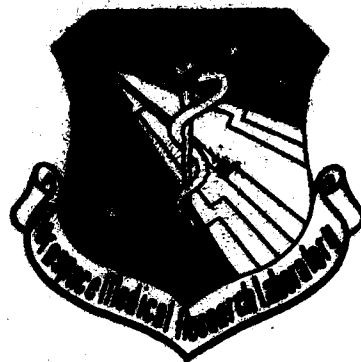
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**FIELD STUDIES OF THE AIR FORCE PROCEDURES
(NOISECHECK) FOR MEASURING COMMUNITY NOISE
EXPOSURE FROM AIRCRAFT OPERATIONS**

R. A. LEE

MARCH 1982

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**AIR FORCE AEROSPACE MEDICAL RESEARCH LABORATORY
AEROSPACE MEDICAL DIVISION
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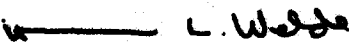
TECHNICAL REVIEW AND APPROVAL

AFAMRL-TR-82-12

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

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FOR THE COMMANDER


WILLIAM L. WELDE
Associate Director (Act'g)
Biodynamics & Bioengineering Division

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20. ABSTRACT (Continued)

→ The total noise exposure level at a specified location has an uncertainty associated with it whether the level is predicted or measured. The purpose of NOISECHECK is to determine the total noise exposure in terms of the Day-Night Level (DNL) metric for a specified ground location from direct measurements. NOISEMAP predicts DNL values for yearly-averaged "busy days" aircraft operations. Therefore, the direct DNL measurements need to be normalized to this "busy day" DNL. The NOISECHECK Procedures lead you through these normalizations in a straightforward step-by-step method. The results of the Laughlin and Homestead tests show that, with the proper data collection, the NOISECHECK procedures can validate the long-term noise exposure and explain any differences between the NOISEMAP predicted DNL values and the short term measurement DNL values.

A

SUMMARY

This report describes the results of noise measurements at Laughlin and Homestead AFB to field test the NOISECHECK equipment and procedures developed under contract by Bolt, Beranek and Newman, Inc. NOISECHECK is the equipment and procedures required to spot check or validate the long term noise exposure predicted by NOISEMAP, the USAF computer program for predicting the noise exposure from aircraft operations.

The first field study was done at Laughlin AFB to validate the high noise exposure levels, 80 dB and 75 dB Day Night Levels (DNL), in a high air traffic density area. The data at Laughlin showed good agreement at one location and a definite disagreement at two other sites between the measured and NOISEMAP predicted values. This discrepancy could not be resolved due to inadequacy of the aircraft operational data collected, although a probable cause is discussed. At Homestead AFB due to careful collection of the logs of the aircraft operations, we were able to use the recommended NOISECHECK procedure of synthesizing the DNL from measured SELs to find out what causes the differences between measured and NOISEMAP predicted DNLs. After correcting the erroneous operation inputs to NOISEMAP discovered by this procedure, we had excellent agreement at both measurement locations.

This report shows that with the proper pre-field test planning and data acquisition techniques, NOISECHECK can effectively determine if there are differences between long-term predicted values and short-term measured values of total noise exposure and what caused the differences. This report also proposes a method for increasing the security of the monitors (a serious and potentially expensive problem with any unattended unit) and for simplifying the NOISECHECK procedures. This new simplified procedure will reduce by one-half the work to prepare for a field test, will provide a screening method for data collection at each site, and help simplify the data analysis.



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PREFACE

This report was prepared by the Biodynamic Environment Branch (AFAMRL/BBE), Aerospace Medical Research Laboratory, under Air Force Systems Command Project/Task 723107, Technology To Define and Assess Environmental Quality of Noise From Air Force Operations. The author of this report gratefully acknowledges the personal interest and efforts of Mr. Dwight Bishop, the principle author of the NOISECHECK procedures report on which this report is based, Mr. Jerry Speakman who assisted in the field measurements and Mrs. Norma Peachey who typed this report.

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I. INTRODUCTION

A vital part of Air Force environmental noise planning efforts is the need to perform spot-check noise measurements which provide data supporting predicted noise exposure values and the corresponding decisions made regarding land use compatibility and environmental noise impact. The objective of this effort was to field test, evaluate and modify, if needed, the aircraft noise monitoring technology developed under Air Force contract #F33615-77-C-0514 by Bolt Beranek and Newman Inc. This technology will be used by the Air Force in collecting field measured noise exposure data acceptable as evidence in cases involving extreme controversy or litigation.

This report details the two field tests that were conducted to evaluate this NOISECHECK technology. The first test was conducted at Laughlin AF Base, an Air Training Command base, located near Del Rio, Texas. The second test was conducted at Homestead AFB, a Military Airlift Command base, located near Homestead, Florida. The two bases are typical of the differences in aircraft number and mix that occur at the various Air Force bases. Laughlin AFB has two main aircraft with the T-37s dominating the noise exposure on the west side of the base and the T-38s on the east side. At Homestead, the F-4s dominated the total noise exposure everywhere. Other major differences at the two bases include the following: (1) The T-38 and T-37 aircraft at Laughlin AFB were considerably quieter than the F-4 aircraft at Homestead AFB; (2) Laughlin AFB averaged about 360 T-38 and 300 T-37 aircraft operating per day, while Homestead averaged about 100 F-4 operations per day; (3) Detailed daily records of the F-4 operations on individual flight tracks were available at Homestead AFB, whereas only the total daily tower traffic count was available at Laughlin due to the large number of operations per day. Since all AF bases exhibit similar kinds of differences, it was found that the NOISECHECK measurements and procedures need to be custom formed for each base, site and purpose following a general procedure.

This report is structured around the four main stages of a typical NOISECHECK test (test preparation, data acquisition, data analysis, and test analysis). The two tests are detailed separately, Laughlin first then Homestead, to show the difference in approaches used for the two tests. At Laughlin we were attempting to refine the NOISECHECK procedures into cookbook form to be used at all bases by non-experienced personnel. When we did the study at Homestead about seven months later we realized that this was not practical. We then used the approach of refining a general procedure that would be tailored for each specific base/site/purpose by personnel knowledgeable about the NOISEMAP program and experienced in making measurements of total noise exposure.

II. EQUIPMENT CHECKOUT

Before conducting any NOISECHECK test, the equipment should be examined to make sure it is in proper operating condition. Following is a simple checkout procedure that can be used to determine if all aspects of the NOISECHECK units are operational.

NOISECHECK programs involve a basic noise-monitoring unit: Digital Acoustics DAI 607P. It comprises a standard sound level meter with built-in digital computing and memory capabilities and a printer. This unit can process, store, and print-out either single-event or continuous noise exposure data. Print-out of Hourly Noise Level (HNL), Day Night Level (DNL) data, etc., can be on demand or at specified intervals.

The digital circuitry of the DAI 607P samples the electrical signal that would be fed to an indicating meter in a standard sound level meter eight times a second and then uses these sampled levels in digital computations. The output of this NOISECHECK unit is in two forms: an LED display for visual observation and printouts on a thermal printer for permanent records.

The DAI 607P has been designed for routine output of the Day Night Level (DNL) used for aircraft noise analyses. It also measures and prints out the Hourly Noise Level (HNL) as well as the Sound Exposure Level (SEL) and maximum A-level of individual noise events that rise above a selectable noise threshold. Incorporated in the unit is an accurate time clock, which records the time of day at which single events occur. The DAI 607P has the option to output percentile distribution functions of the measured A-level over specified time intervals, data which can be used for non-aircraft noise analyses.

A Gen Rad 1567 114 dB, 1000 Hz calibrator is used for the field calibration of the DAI 607P. This NOISECHECK monitor has a built-in safeguard so that no data will be taken unless the system is first calibrated.

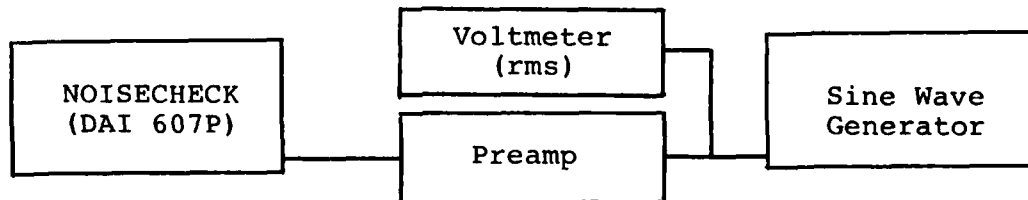
The microphone is a Gen Rad 1962-9601, an electret form of a condenser-type microphone. This microphone was chosen for NOISECHECK programs because they have moderate sensitivity and excellent frequency response, and they can tolerate a wide range of operating conditions.

A microphone windscreen of porous foam is provided not only to reduce the noise of wind but also to protect the microphone from rain and snow.

Because the electrical signals generated by the microphone are small, it is attached directly to a preamplifier, a stable, low self-noise, electrical amplifier that transmits the enhanced electrical signal over a cable to the DAI 607P.

The checkout of the NOISECHECK equipment can be accomplished in any electronics lab using only two pieces of standard equipment, an rms voltmeter and a sine wave generator. A description of the NOISECHECK keyboard is detailed in the NOISECHECK procedures report (Ref. 1). The NOISECHECK equipment was verified to be in proper working order prior to our field use by using the following procedure:

Set up NOISECHECK instrumentation as follows:



A. CALIBRATION

1. Set Generator at 1000 Hz, 1 volt rms
2. Turn NOISECHECK instrument on (on, A-weighting, fast)
3. Wait 30 seconds
4. Press (set, 9, enter, read, 1, enter)
Display should read 114.0 dB
5. Press (print, 0, enter)
System should printout system status

B. FREQUENCY WEIGHTING CHECK

1. Press (print, 11, enter)
2. Set Generator at 50 Hz, 1 volt rms
3. Press (read, 1, enter)
Display should read 83.8 dB*
4. Set switch to flat
5. Press (read, 1, enter)
Display should read 112.7*

-
1. Bishop, D. E., Harris, A. S., Mahoney, J., Rentz, P. E.:
NOISECHECK Procedures for Measuring Noise Exposure From Aircraft
Operations, AFAMRL-TR-80-45, Nov 1980.

6. Repeat steps 2 through 5 for the following values:

| <u>Frequency</u> | <u>A-Weightings Should Read:</u> | <u>Flat Should Read:</u> |
|------------------|--------------------------------------|------------------------------|
| 100 Hz | 94.9* | 113.7* |
| 500 Hz | 110.8* | 114.0* |
| 1000 Hz | 114.0* | 114.0* |
| 5000 Hz | 114.5* | 112.7* |
| 10 KHz | 111.5* | 109.6* |

* NOTE: Values should read within ± 0.5 dB.

C. DYNAMIC RANGE CHECK

1. Set Generator at 100 Hz, 2 volts rms
2. Set switch to A-weighting
3. Press (read, 1, enter)
Display should read 120.0 dB
4. Disconnect the Generator and short the input to the preamp
5. Press (read, 1, enter)
Display should read less than 5.0 dB

D. INTEGRATION CHECK

1. Press (print, 1, enter)
2. Set the Generator at 1000 Hz, 1 volt rms
3. Using a stopwatch connect the Generator for 100 seconds
System should print-out: SEL = 134.0 dB
MAX = 114.0 dB
4. Press (set, 19, enter, 40 enter)
5. Using a stopwatch connect the Generator for 2 seconds
System should NOT print-out anything
6. Using a stopwatch connect the Generator for 6 seconds
System should print-out SEL and MAX values
7. Press (set, 20, enter, 80, enter)
8. Using a stopwatch connect the Generator for 5 seconds,
wait 5 seconds, then reconnect for another 5 seconds
After 10 seconds system should print-out one SEL value with
a duration greater than 15 seconds
9. Using a stopwatch connect the Generator for 5 seconds,
wait 11 seconds, then reconnect for another 5 seconds
System should print-out 2 SEL values each with a duration
less than 10 seconds

E. DISTRIBUTION FUNCTION CHECK

1. Press (print, 11, enter, print, 6, enter, set, 8, enter,
0.01 enter, set, 23, enter)
System should print-out L(x) values after 1 minute

2. Press (read, 40, enter)
System should display time (mm, ss) on internal clock
 3. When the clock starts a new minute interval, connect the Generator for 3 seconds
Systems should print-out the L(x) values with only the L(.1) through L(5) values equal to 114.0 dB
 4. Repeat steps 2 and 3 connecting the Generator for the following times:

6 seconds - only the L(.1) through L(10) values should = 114.0 dB
30 seconds - only the L(.1) through L(50) values should = 114.0 dB

54 seconds - only the L(.1) through L(90) values should = 114.0 dB
60 seconds - all L(x) values should equal 114.0 dB
 5. Press (print, 16, enter)
- F. ACOUSTIC LEVEL CHECK
1. Set switch to flat.
 2. Disconnect voltmeter and sine wave generator.
 3. Connect microphone to preamp.
 4. Place GR 1567 calibrator on microphone.
 5. Turn calibrator on.
 6. Press (set, 9, enter, read, 1, enter)
 7. Replace GR 1567 calibrator with B&K 4220 pistonphone.
 8. Turn on pistonphone.
 9. Press (read, 1, enter) system should display 124.0 dB \pm .8 dB

TEST COMPLETE

If any tests fail, repeat the test. If test continues to fail, turn unit over to a qualified technician for repair.

III. LAUGHLIN AFB STUDY

Test Preparation

The NOISECHECK procedures report (Ref. 1) in pages 8 through 19 give a detailed synopsis of things that need to be considered when planning a NOISECHECK type test. It includes defining program goals, assembling pertinent information, estimating test duration and gives help for selecting the specific measurement sites.

After coordination with HQ ATC the initial checkout test for the NOISECHECK technology was scheduled at Laughlin AFB. The test was designed to model a litigation problem at Williams AFB that has similar flight operations to Laughlin. This problem at Williams AFB involved a person that wanted to develop his land by building residential dwellings within the Day Night Average Sound Level (DNL) 80 contour. The local Zoning Board refused to let him build because of the incompatibility of a noise environment over DNL 80 with residential property. The litigation involved the validity of the contours predicted by the USAF AICUZ (Air Installation Compatible Use Zone) Program. The developer claimed that it is not as noisy as the NOISEMAP program predicts and therefore he should be allowed to build.

Figure 1 shows the input flight tracks, the NOISEMAP contours and the proposed measurement locations for Laughlin AFB TX. The plan was to conduct the test over a two-week period with four NOISECHECK instruments. Since the DNL 80 contour on the takeoff end of the runway was the primary concern, monitors were to be placed at positions 3 and 4 for the full two weeks. These two monitors should be adequate to define the DNL 80 contour at that end of the runway due to the relatively small land area involved. The other two monitors were to be used for quick checks at the other locations. The monitors were to be placed at locations 1 and 2 for the first week and moved to 5 and 6 for the second week. Site 1 would be the hardest test for NOISEMAP due to the long propagation distance from the nearest flight tracks and the uncertainties in transition angle modeling. Sites 2, 5 and 6 would be used to check the DNL 75 contour closure at locations that would be under virtually all of the takeoff flight tracks.

With the large number of aircraft operations at Laughlin per day (approx. 350 operations/day) it would be very difficult for one person to associate each operation with all the various flight tracks. See Figure 1. The operations count was simplified by consolidating some flight tracks and only counting the operations over the measurement locations. The total number of tracks that were needed to count for this test was reduced to ten tracks (see Figure 2). These ten tracks are nicely divided with the four tracks for runway 31L used by the T-37 aircraft and the other six are almost exclusively used by the T-38 aircraft.

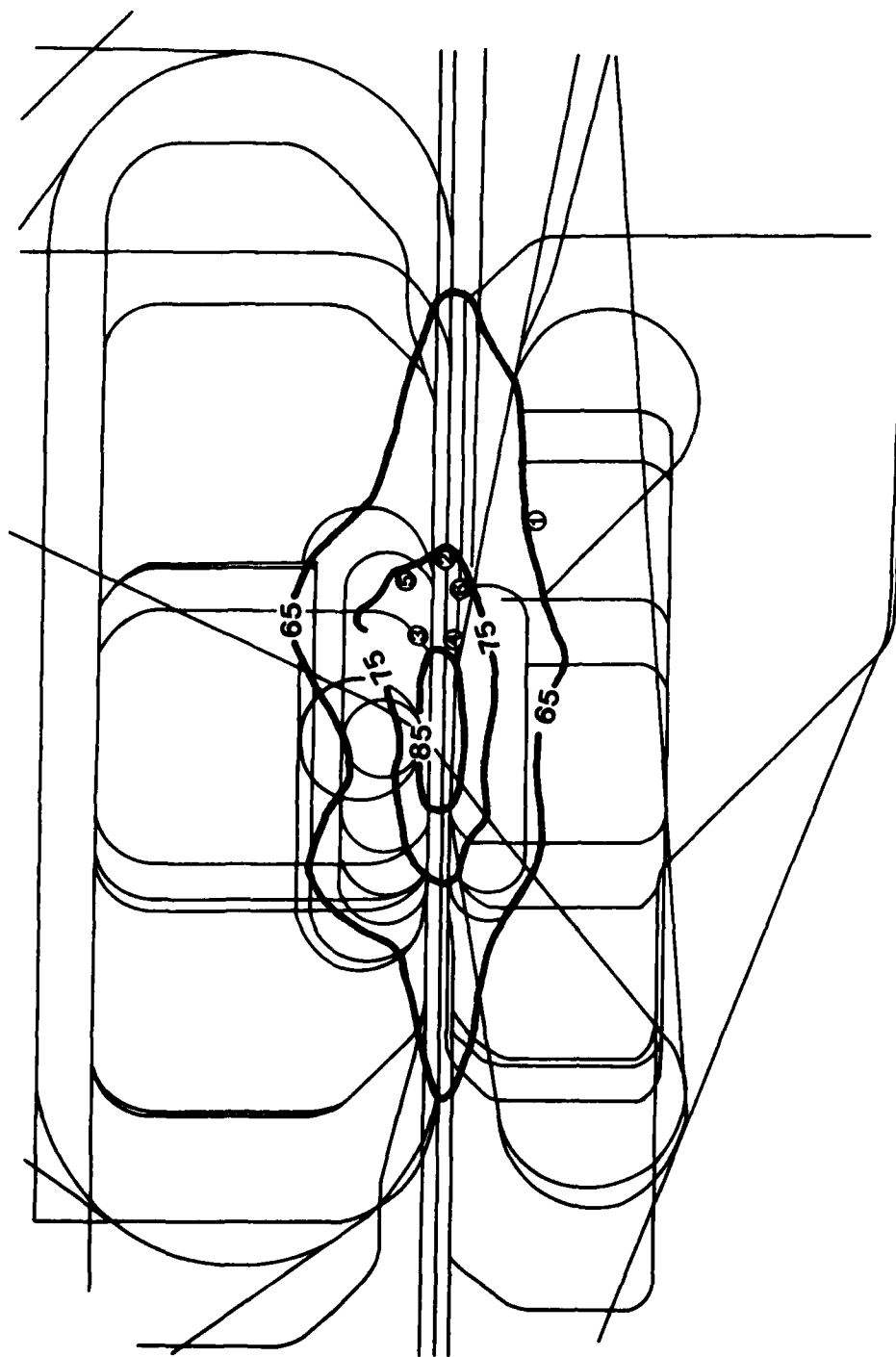


Figure 1. Noise Exposure Contours, Flight Tracks and Proposed Measurement Locations for Laughlin AFB, Texas

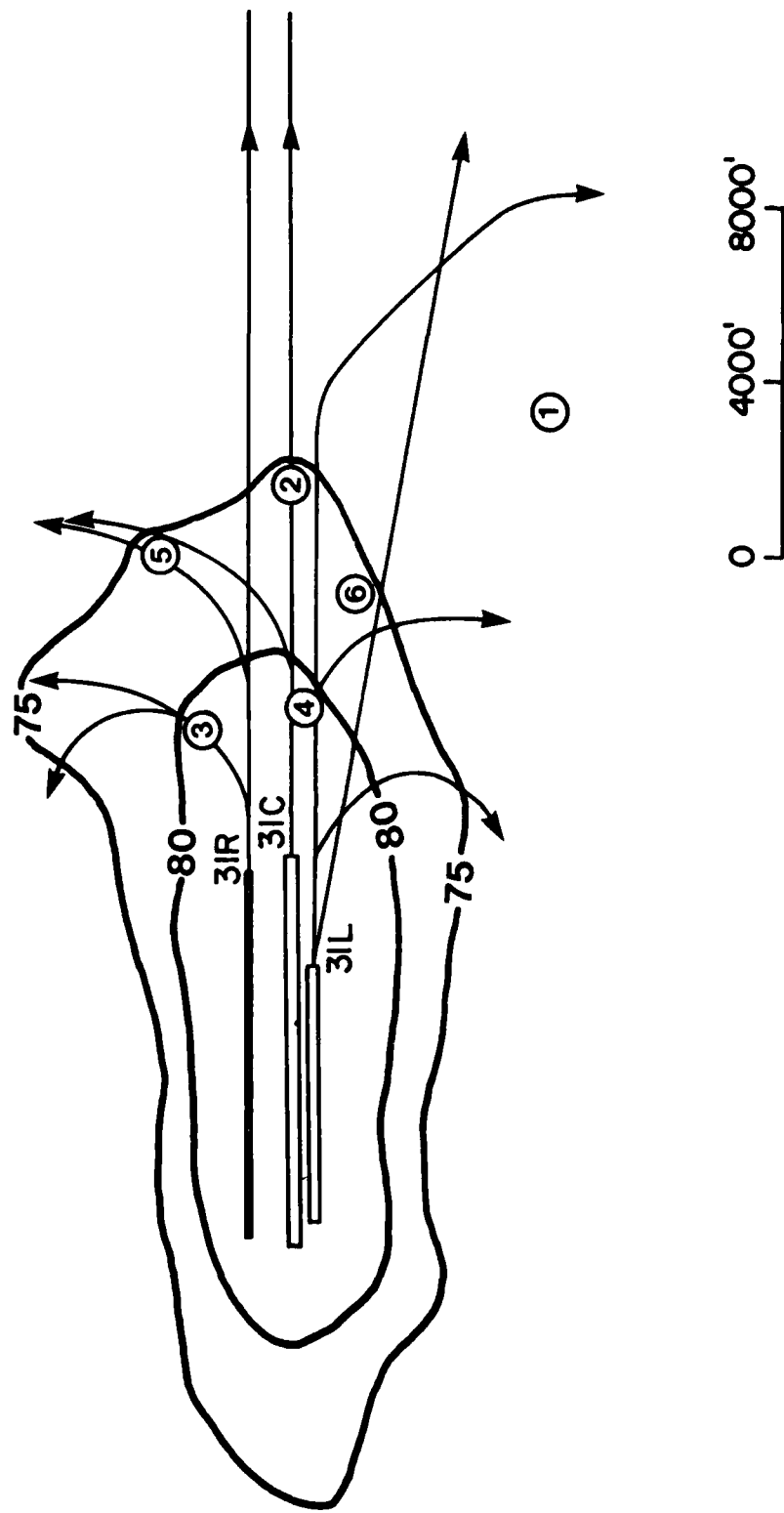


Figure 2. Significant Flight Tracks for NOISECHECK Test at Laughlin Air Force Base, Texas

A point of contact was established at Laughlin AFB in the Base Civil Engineer's Office, the office responsible for the base's input to NOISEMAP and the AICUZ program. A detailed test plan, AMRL/BBE-TP-29 was sent to our point of contact for coordination/information of the Base Commander, Director of Maintenance, Air Traffic Controller, Security and the other base organizations. An orientation meeting was scheduled for the first day to explain the nature, scope and purpose of this study.

DATA COLLECTION AT LAUGHLIN AFB

Initial Setup

Several difficulties were encountered at Laughlin AFB during the first week of the measurement period. Although the measurement locations were known in advance, permission to place our monitors on private land was not obtained prior to the test. It took several days to locate the owners so it wasn't until Wednesday, 14 Feb 79, that the first monitors were put in the field. The next day the NOISECHECK Unit at Location 1 began malfunctioning. After recalibrating, the system worked for another half a day and then quit completely. (After the test, this unit was sent back to the manufacturer where it was learned the problem was a faulty memory chip.) This left us with monitors at Locations 2, 3 and 4 for the first full measurement day on Thursday. But Thursday afternoon the wind shifted enough to switch runways, so instead of the planes taking off, they were landing over our measurement locations. This adverse wind condition continued until the following Tuesday. This was causing our measurement period to not be representative of the yearly averaged operations at Laughlin, so the measurement period was extended another week and the plans to measure at Locations 5 and 6 were dropped. At the end of the second week the system at Location 2 began malfunctioning and no reliable data were acquired at that location after Thursday, February 22. Therefore, in the overall analysis of this test, it should be noted that these data from Location 2 will be for a different measurement period than data at Locations 3 and 4 and will be compared to NOISEMAP predicted values for different aircraft operations.

Collection of Acoustic and Weather Data

The NOISECHECK units were set to print-out hourly noise levels (HNL), community noise exposure levels (CNEL) and day-night levels (DNL) for the complete duration of the test. Sound exposure levels (SEL) were also acquired for a limited number of aircraft operations, when an operator was present to identify the particular operation. The operator annotated on the print-outs the particular operation which could then be time correlated with the other units. Table A-1 lists the HNLs, CNELs and DNLs collected from the monitors. Table A-2 lists the temperature and relative humidity during the test. The blocked-in areas of the weather table indicate the times when there were aircraft activity at any of the measurement locations.

Data Collection for Aircraft Operation Information

At Laughlin AFB the only record of aircraft operations was the traffic count figures kept by Base Operations. These figures were split out by T-37 and T-38 operations but there was no exact tabulation of aircraft operations by flight track. Since sufficient manpower was not available to do an exact count of aircraft operations by flight track for the entire test, a sampling method was used. A man stationed at the runway supervisory unit (RSU) located at each runway logged the aircraft into three categories - takeoff, crosswind and closed during busy times of the day. The utilization of flight tracks during these busy times was then applied to the T-38 and T-37 totals to come up with the totals by flight track to compare to the NOISEMAP chronicles. Table A-3 gives the flight track utilization as observed by the man in the RSU units. Table A-4 gives the daily traffic count collected for Base Operations. Note: The traffic count is exactly twice the number of operations that occur over one end of the runway; i.e., during a takeoff and landing we would have one event over the NOISECHECK units but the traffic count would be two. Tables A-5 and A-6 give the calculated daily operations and average busy day operations for the test period by flight track for direct comparison to the NOISEMAP inputs.

Engine power settings, airspeed and aircraft altitude at microphone locations were obtained by interviewing several pilots. Photos taken from the microphone location with the aircraft at the point of closest approach to the microphone were used to verify the aircraft altitude profiles. Table A-7 gives the pilots' summary of power setting, airspeed and altitude profile over the microphone locations. Table A-8 gives the altitude summary from the photographs.

Collection of this operations information was a very tedious and time consuming task due to the large number of flight tracks at Laughlin AFB. Even with consolidating flight tracks to the gross categories of straight-out, crosswind and closed departures, operations information was not verified for all situations. Where no information was obtained, it was assumed that the NOISEMAP inputs were representative of the test period. The difficulties encountered in trying to verify all noise sources during the test period have demonstrated the need for a screening process to limit the number of flight operations that need to be verified. A recommendation for determining the major contributors at a specific ground location will be discussed later in this report.

DATA ANALYSIS AT LAUGHLIN AFB

Background Information for Data Analysis

Any value of total noise exposure at a specified location has an uncertainty associated with it. This is true whether the value is

predicted or measured. The purpose of NOISECHECK is to determine the total noise exposure in terms of the Day-Night Level (DNL) metric for a specified ground location from direct measurements. Although direct measurements of the DNL are appealing to most people as the firm number that a prediction should be compared to this is not necessarily true. If measurements were made of the DNL for a two week period the results would only be representative of the noise exposure for that measurement period. If measurements were made for another two week period, these two DNL values could and probably would be different. The NOISEMAP program predicts DNL values for the yearly averaged "busy day" aircraft operations. This yearly averaged busy day DNL is the value that we want the NOISECHECK measurements to represent.

The NOISECHECK procedures report (AFAMRL-TR-80-45) in pages 38 to 77 delineate the two procedures for analyzing the NOISECHECK data. The two procedures are the direct measurement DNL analysis and the calculated DNL from measured sound exposure levels (SEL) analysis. The direct measurement DNL analysis takes the daily DNL values measured by the NOISECHECK monitors and adjusts them to average busy day operations by adding the correction factor of $10 \log (\text{busy day operations} / \text{daily operations})$. This method usually takes a long measurement period to obtain a specific confidence interval because you can usually only obtain five DNL values during a week's worth of measurements (most Air Force bases don't fly full operations on Saturday and Sunday). Figure 3 shows the number of measurements required to be 90% confident that the final DNL is within a specific interval for various amounts of scatter in the data. For example, if the measured DNLs had a 5 dB scatter, it would take 30 measurements (6 weeks) to obtain a direct measured DNL value that you could be 90% confident that the true busy day DNL was within a ± 1.5 dB interval around the measured value or 65 measurements (13 weeks) to be within a ± 1 dB interval.

Also, since DNL contributions by different aircraft or operations are not identified, less information is available to determine possible reasons for any sizable difference between measured DNL and the DNL computed from NOISEMAP.

The second method of analysis described in the NOISECHECK procedures report is to synthesize the DNL from measured SELs. Since you can obtain many SELs during a day's measurements, the amount of data is much greater than the measured DNLs. This method is required if the duration of the field measurement program is limited and reasons for possible discrepancies are desired. The analysis process consists of correlating portable noise level monitor SELs with individual operations from on-site logs or Tower Logs and combining the energy average of these measured SELs for a particular operation with the average busy day number of operations. The average busy day number of aircraft operations is the input to NOISEMAP so these

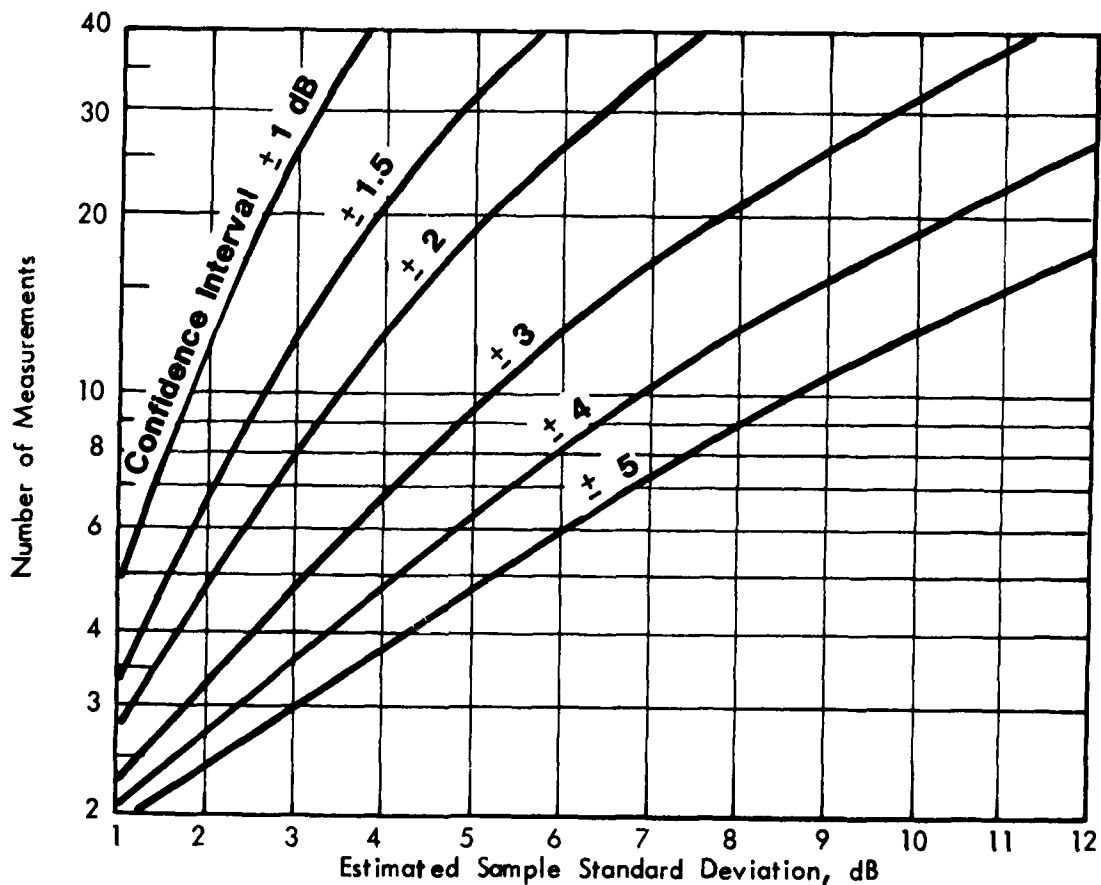


FIG. 3. NUMBER OF MEASUREMENTS NEEDED TO ASSURE A 90% CONFIDENCE INTERVAL. (From NOISECHECK Procedures Report: Ref. 1.)

numbers can be obtained from the NOISEMAP chronicles. It is important to note that the NOISECHECK technology does not attempt to determine what is the average busy day number of aircraft operations. This is left for the base AICUZ officer to determine, since there is no way that any two to three week survey can adequately determine yearly operation averages. Still it is incumbent upon the investigator to verify the operation inputs by interviewing several sources. For example, pilots, standard evaluation, the base AICUZ officer, Base Operations and tower personnel.

1. Direct Measurement DNL Analysis at Laughlin AFB TX

In order to fill out Worksheet 1 we need to determine the effective number of operations over each site on a daily basis during the measurement period and the NOISEMAP effective number of operations that contribute to that location's DNL value.

The base traffic count gives us the daily activity by runway. The tower count is the center runway activity which is 99% T-38 activity. Lariat Count is the east runway and is all T-38 activity. Honcho Count is the west runway and is all T-37 activity. By determining the major DNL contributors at each measurement location from NOISEMAP we can determine how much individual operations influence each measurement point. Since determining the major contributors at each location is the most important part of the NOISECHECK analysis, the section from the procedures report on rank ordering the DNL contributors at a site is included in Appendix C of this report. The list of DNL contributors for each measurement location at Laughlin AFB (Worksheet 9) are presented in Figures 4A - 4c. The flight track descriptor tells what runway is used. Runway 13 is a takeoff over the measurement locations and runway 31 is a landing over the measurement locations. C stands for the center runway, L for left, and R for the right runway. Therefore, 31R and 13L are the T-38 activity on the east runway, 31C and 13C are the center runway and 31L and 13R are the T-37s on the west runway. From these worksheets we can see that on an average busy day none of the three sites are affected significantly by any T-37 activity or any landings. Site 2 is dominated by the T-38 departures from the center runway and the crosswind patterns from the east runway. Site 3 is dominated by a mixture of all three T-38 operations, closed, crosswind and departure. Site 4 is dominated by the center runway departures. Figure 5 shows the effective number of dominant operations for an average busy day from the NOISEMAP inputs, the daily number of dominant operations from the tower count and the adjustment to be applied to the measured daily DNLs for each site. These adjustments are now input into the Worksheet 1s for each site (see Figures 6a - 6c). This worksheet then gives us the measurement DNL, the associated standard deviation and the 90% confidence intervals at each site. To compare these values with NOISEMAP we need to determine the NOISEMAP DNL, standard deviation and the 90% confidence intervals at each measurement location. Worksheets 7a - 7c give these values. Next we need to calculate the probability that

the measured DNL and the NOISEMAP calculated DNL are consistent. Figures 8a - 8c (Worksheet 6s) give the probabilities for each location. The final results are summarized in the following table:

| Laughlin AFB Site # | Measurement DNL DNL (M) | NOISEMAP DNL DNL (C) | Probability of Consistency |
|------------------------|----------------------------|-------------------------|-------------------------------|
| 2 | 73.6 | 75.9 | .0072 |
| 3 | 76.8 | 82.7 | .0002 |
| 4 | 80.6 | 81.0 | .7948 |

As can be seen, there is good agreement at Site 4, poor agreement at Site 2 and almost no agreement at Site 3. Although this analysis of the measured DNL shows disagreement with NOISEMAP, it cannot tell us what caused the problem. To find this out, we need a more detailed analysis using the SEL information collected by NOISECHECK.

2. Calculated DNL From Measured SEL Analysis at Laughlin AFB TX

The first step in synthesizing the DNL values from SELs is to identify the operations that produced each individual SEL. At the Laughlin AFB test the main contributors to the DNL were not determined prior to the test. This resulted in a lot of time spent documenting and identifying events that did not significantly contribute to a site's DNL (i.e., none of the T-37 activity was a major contributor at any of the measurement sites but amounted to about one-half of the operations data collected). Also, because of the large amount of aircraft activity the operations were grouped into gross categories that did not always match up with the NOISEMAP inputs. Although we had a man in the RSU units logging actual takeoff, crosswind and closed loop patterns for the T-38s, those could not be correlated with the NOISECHECK units. This was because the observer grouped activity into three minute time segments in order to keep up with the large amount of activity and at the monitor sites often the noise levels from one activity did not drop off before another started merging the levels together. Therefore, a synthesized DNL from SELs is not possible from the data collected at Laughlin. But some information can be gained by looking at the SELs that were identified for each location and these are presented in this section.

In order to compare SEL values that were measured to the NOISEMAP SEL values, we need to condense the NOISEMAP contributors into the same categories as the measured SELs and rank order them. For example, at Site 2 the top two main contributors are the T-38 departures on the center runway (Flt tracks 13CA & 13CG). They produce SEL values of 100.3 and 100.6 respectively. These we combine by taking the energy average of the SELs and adding the number of operations together to make the new operation called T-38 departure (Note: this will produce slight errors due to uneven numbers of operations but it is the only way to compare to the measured categories). This T-38 departure for Site 2 has an SEL of 100.5 and 178.9 effective

operations. These regrouped flight tracks are rank ordered for each site and presented in Table 1. This rank ordering demonstrates the relative importance of individual SEL values. Table 2 compares the NOISEMAP predicted values for the important events at each site to the SELs that were identified from the NOISECHECK measurements. Table 2 also compares the slant distances that were input to NOISEMAP with the slant distances we measured using a photographic scaling technique from pictures taken at each site. Included in Table 2 are the number of events that were used to determine the measured values. Even with this scant amount of single event data, several things can be concluded. At Site 4 we had very good agreement between measured and NOISEMAP values and this is reflected in the single event levels. The T-38 departures were louder than predicted by only 1.7 dB. This can be explained by the slant distance difference. Although we only had one photograph that showed an altitude of 640 feet, the pilots we interviewed seem to agree that their altitude over Site 4 would be somewhere around 500 feet AGL. The NOISEMAP value is 900 feet AGL and explains why NOISEMAP would slightly underpredict the values. The opposite is true for the crosswind patterns from the left runway. The measured values are lower but the slant distance is further than the NOISEMAP values. These two offsetting situations make the combined noise exposure very close to the NOISEMAP values. The T-38 closed loop patterns seem to agree very well at this location. Site 4 shows the same close agreement in the SELs as in the DNL analysis.

At Site 3 the problem of not identifying the major contributors prior to the test was made clear. Although we documented numerous events at Site 3 we had no slant distance pictures and only one identified SEL for each of the two major contributors. This is unfortunate since Site 3 was where we had the largest discrepancy between measured and predicted values. From field observation we noticed that the closed loop patterns were turning quite a ways before Site 3 and NOISEMAP has that flight track coming within a few hundred feet of the site. The T-38 pilots informed us that they were turning up much shorter than the NOISEMAP tracks but that was only because the airplane performed better in the cool weather that we had at Laughlin during our measurement time frame. According to the pilots, in the summer months the aircraft will turn over the measurement location. So therefore, here is a case where the measurement was of a different event than what NOISEMAP predicted and NOISECHECK showed this clearly. It also shows that in all likelihood the measurement did not represent the long term average of total noise exposure at that site.

At Site 2 the closed loop pattern of the T-38 sound exposure levels seem to agree very well. Note: The NOISEMAP levels presented here does not take into account the NOISEMAP turn algorithm which would decrease the NOISEMAP predicted values for the closed loop pattern at this location. The slant distances from the photographs at this site are less than the NOISEMAP slant distances. This would seem to indicate that the T-38s were turning further out than the NOISEMAP ground track contradicting what we saw while at Site 3. But this can be explained because while we were at Site 2 we did not

photograph all of the T-38 closed loop patterns but only those that came near us biasing us to the shorter slant distance. The measured SEL values for the other two patterns, T-38 departure and crosswind, are definitely less than the NOISEMAP values. The only thing that could account for this would be a power cutback by the aircraft before reaching this measurement location. Even if we adjust the NOISEMAP values for the slant distances we measured (depart would be 102.7 and crosswind would be 100.2), we still measured values around 6 dB less than predicted. A power cutback would have been possible due to the better aircraft performance during our measurement period. (See comments on Site 3.) A power cutback to the normal throttle back position would be around 95%-96% RPM. This would mean a noise level reduction of about 7-9 dB. Again, this explains that NOISEMAP was looking at a different situation than was measured. Yet if the pilots had not done a power cutback (as we suspect they did) before our measurement points, the noise levels for those two operations (depart and crosswind) would have brought the measurements more in line with the long term average exposure predicted by NOISEMAP.

At Laughlin AFB the average temperature and relative humidity for the measurement period when there were aircraft operations was 81°F and 60% relative humidity. To normalize the noise data (SELs) to the standard day weather (59°F and 70% relative humidity) that is used by NOISEMAP would result in corrections to the measured SELs of less than 0.1 dB. Therefore, no corrections were made to the measured data to normalize to the standard day weather conditions.

[illegible]

Use
Equations
in
Supple-
ment

[illegible]

25

Site Number 4
 Engineer Robert Lee
 Date _____

| From Worksheet 8 | | | | | |
|------------------|------------|---------|--------------|----------------|------------------|
| Aircraft | Operation | Flt Trk | Aircraft SEL | Day Operations | Night Operations |
| T-38 | Depart | 13CA | 106.8 | 110.1 | 2.7 |
| T-38 | Depart | 13CG | 105.5 | 41.8 | 0 |
| T-38 | Cross-wind | 13LD2 | 105.0 | 15.5 | 0 |
| T-38 | Cross-wind | 13LD1 | 104.5 | 10.2 | .6 |
| T-38 | Cross-wind | 13CE | 107.8 | 7.6 | 0 |
| T-38 | Closed | 13LD3 | 96.8 | 21.3 | 4.0 |
| T-38 | Cross-wind | 13LE1 | 103.6 | 10.1 | .2 |
| T-38 | Cross-wind | 13LH | 103.6 | 11.7 | 0 |
| T-38 | Closed | 13LE2 | 97.8 | 22.9 | 1.2 |
| T-37 | Depart 100 | 13RA | 91.9 | 84.7 | 1.7 |
| T-38 | Landing | 31CG | 97.0 | 10.4 | 0 |
| T-38 | Landing | 31CB2 | 94.7 | 9.5 | .3 |
| T-37 | Closed | 13RD1 | 86.2 | 61.0 | 1.2 |
| T-37 | Landing | 31LF1 | 89.0 | 23.5 | 1.4 |
| T-37 | Landing | 31LF2 | 96.5 | 2.9 | 0 |
| T-38 | Landing | 31RF | 85.7 | 25.2 | .9 |
| T-38 | Landing | 31RD | 84.1 | 11.8 | 1.1 |
| T-37 | Closed | 13RD2 | 87.1 | 8.8 | 0 |
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Use
Equations
in
Supple-
ment

| Calculated | | | |
|---------------------------------|-------------|-------------|------------------------|
| Effective Numbers of Operations | Partial DNL | Rank Number | Total DNL Through Rank |
| 137.1 | 78.8 | 1 | 78.8 |
| 41.8 | 72.3 | 2 | 79.7 |
| 15.5 | 67.5 | 3 | 79.9 |
| 16.2 | 67.2 | 4 | 80.2 |
| 7.6 | 67.2 | 5 | 80.4 |
| 61.3 | 75.3 | 6 | 80.5 |
| 12.1 | 65.0 | 7 | 80.6 |
| 11.7 | 64.9 | 8 | 80.7 |
| 34.9 | 63.8 | 9 | 80.8 |
| 101.7 | 62.6 | 10 | 80.9 |
| 10.4 | 57.8 | 11 | 80.9 |
| 12.5 | 56.3 | 12 | 80.9 |
| 73.0 | 55.4 | 13 | 80.9 |
| 37.5 | 55.3 | 14 | 81.0 |
| 2.9 | 51.7 | 15 | 81.0 |
| 34.2 | 51.6 | 16 | 81.0 |
| 22.9 | 48.3 | 17 | 81.0 |
| 8.8 | 47.1 | 18 | 81.0 |
| | | | |
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FIG. 4c. Worksheet 9 for Site 4 at Laughlin AFB TX

| Date | Daily Dominant Ops | | | Adjustment to Ave Busy Day Ops | | |
|--------|--------------------|--------|--------|--------------------------------|--------|--------|
| | Site 2 | Site 3 | Site 4 | Site 2 | Site 3 | Site 4 |
| Feb 14 | 182 | 449 | 139 | 1.2 | -1.2 | 2.2 |
| Feb 15 | 61 | 244 | 31 | 6.0 | 1.4 | 8.7 |
| Feb 16 | Land Operations | | | | | |
| Feb 17 | Saturday | | | | | |
| Feb 18 | Sunday | | | | | |
| Feb 19 | Holiday | | | | | |
| Feb 20 | 127 | 169 | 120 | 2.8 | 3.0 | 2.8 |
| Feb 21 | 135 | 248 | 131 | 2.5 | 1.3 | 2.4 |
| Feb 22 | 221 | 832 | 122 | .4 | -3.9 | 2.7 |
| Feb 23 | Landing Day | | | | | |
| Feb 24 | Saturday | | | | | |
| Feb 25 | Sunday | | | | | |
| Feb 26 | 283 | 713 | 213 | -.7 | -3.2 | .3 |
| Feb 27 | 320 | 723 | 254 | -1.2 | -3.3 | -.5 |
| Feb 28 | Landing Day | | | | | |
| Mar 1 | 389 | 654 | 346 | -2.1 | -2.9 | -1.8 |
| Mar 2 | 121 | 238 | 102 | 3.0 | 1.5 | 3.5 |

Effective number of operations for NOISEMAP

| | | |
|--------|--|-------|
| Site 2 | Flt tracks 13CA, 13CG, 13CE, 13LE1, 13LD1, 13LD2, 13LH (T-38 Departures & Crosswind Patterns) (T-38 Center Runway + 14% Left Runway) | = 242 |
| Site 3 | 13CA, 13CG, 13CE, 13LE, 13LD, 13LH (All T-38 Takeoff Activity) | = 338 |
| Site 4 | Flight Tracks 13CA, 13CE, 13CG (T-38 Center Runway Activity) | = 228 |

Figure 5. Adjustment for Measurement DNL to Average
Busy Day Operations for Laughlin AFB TX

Site Number 2
 Engineer Robert Lee
 Date _____

| Date | Day of Week | From Paper Tape | | Bkgrnd. DNL (1) | DNL' (2) | Effective No. of Oper. (3) | No. Adj. (4) | Adj. DNL |
|--------|-------------|-----------------|---------------|-----------------|----------|----------------------------|--------------|----------|
| | | Day No. | Meas. DNL | | | | | |
| Feb 14 | Wed | | | | | | | |
| Feb 15 | Thur | | 67.7 | 40 | 67.7 | 61 | 6.0 | 73.7 |
| Feb 16 | Fri | | 64.9 | 40 | 64.9 | Landing Operation | NA | NA |
| Feb 17 | Sat | | 32.9 | | | | | |
| Feb 18 | Sun | | 47.9 | | | | | |
| Feb 19 | Holiday Mon | | 41.9 | | | | | |
| Feb 20 | Tue | | 70.8 | 40 | 70.8 | 127 | 2.8 | 73.6 |
| Feb 21 | Wed | | 71.1 | 40 | 71.1 | 135 | 2.5 | 73.6 |
| Feb 22 | Thur | | EQUIPMENT | | | | | |
| Feb 23 | Fri | | MALFUNCTIONED | | | | | |
| Feb 24 | Sat | | | | | | | |
| Feb 25 | Sun | | | | | | | |
| Feb 26 | Mon | | | | | | | |
| Feb 27 | Tue | | | | | | | |
| Feb 28 | Wed | | | | | | | |
| Mar 1 | Thur | | | | | | | |
| Mar 2 | Fri | | | | | | | |

(1) From Eq. 1 or Other Information

(2) From Eq. 2

(3) From Tower Log Analysis

(4) Adjustment = $-10 \log \frac{\text{Effective No. of Oper.}}{\text{NOISEMAP Effective No. of Oper.}}$

| Calculated | |
|----------------------------|-----------------|
| Measurement Std. Deviation | Measurement DNL |
| 308,080 | 73.6 |

90% CI = 73.7 to 73.6

FIG. 6a. Worksheet 1 for Site 2 at Laughlin AFB TX

Measurement Program _____ Sheet _____ of _____

| | |
|-------------|------------|
| Site Number | 3 |
| Engineer | Robert Lee |
| Date | |

| Date | Day of Week | From Paper Tape | | Bkgrnd. DNL (1) | DNL' (2) | Effective No. of Oper. (3) | No. Adj. (4) | Adj. DNL |
|--------|-------------|-----------------|-----------|-----------------|----------|----------------------------|-------------------|----------|
| | | Day No. | Meas. DNL | | | | | |
| Feb 14 | Wed | | | | | | | |
| Feb 15 | Thur | | 77.7 | 45 | 77.7 | 244 | 1.4 | 79.1 |
| Feb 16 | Fri | | 74.5 | 45 | 74.5 | NA | Landing Operation | |
| Feb 17 | Sat | | 53.6 | | | | | |
| Feb 18 | Sun | | 52.7 | | | | | |
| Feb 19 | Holiday Mon | | 54.9 | | | | | |
| Feb 20 | Tue | | 73.3 | 45 | 73.3 | 169 | 3.0 | 76.3 |
| Feb 21 | Wed | | 77.2 | 45 | 77.2 | 248 | 1.3 | 78.5 |
| Feb 22 | Thur | | 77.0 | 45 | 77.0 | 832 | - 3.9 | 73.1 |
| Feb 23 | Fri | | 76.9 | 45 | 76.9 | NA | Landing Operation | |
| Feb 24 | Sat | | 68.4 | | | | | |
| Feb 25 | Sun | | 64.2 | | | | | |
| Feb 26 | Mon | | 78.4 | 45 | 78.4 | 713 | - 3.2 | 75.2 |
| Feb 27 | Tue | | 80.9 | 45 | 80.9 | 723 | - 3.3 | 77.6 |
| Feb 28 | Wed | | 76.4 | 45 | 76.4 | NA | Landing Operation | |
| Mar 1 | Thur | | 78.1 | 45 | 78.1 | 654 | - 2.9 | 75.2 |
| Mar 2 | Fri | | 75.1 | 45 | 75.1 | 238 | 1.5 | 76.6 |

(1) From Eq. 1 or Other Information

(2) From Eq. 2

(3) From Tower Log Analysis

(4) Adjustment = $-10 \log \frac{\text{Effective No. of Oper. NOISEMAP}}{\text{Effective No. of Oper.}}$

| Calculated | |
|----------------------------|-----------------|
| Measurement Std. Deviation | Measurement DNL |
| 20,550,352 | 76.8 |

90% CI = 77.8 to 75.6

FIG. 6b. Worksheet 1 for Site 3 at Laughlin AFB TX

Site Number 4
 Engineer Robert Lee
 Date _____

| Date | Day of Week | From Paper Tape | | Bkgrnd. DNL (1) | DNL' (2) | Effective No. of Oper. (3) | No. Adj. (4) | Adj. DNL |
|--------|-------------|-----------------|-----------|-----------------|----------|----------------------------|-----------------|----------|
| | | Day No. | Meas. DNL | | | | | |
| Feb 14 | Wed | | 80.2 | 45 | 80.2 | 139 | 2.2 | 82.4 |
| Feb 15 | Thur | | 79.1 | 45 | 79.1 | 31 (81 Landings) | Infl by Landing | |
| Feb 16 | Fri | | 74.2 | 45 | 74.2 | Landing Operation | Ops - NA | |
| Feb 17 | Sat | | 43.4 | | | | NA | |
| Feb 18 | Sun | | 57.7 | 45 | | | | |
| Feb 19 | Holiday Mon | | 63.3 | | | | | |
| Feb 20 | Tue | | 77.4 | 45 | 77.4 | 120 | 2.8 | 80.2 |
| Feb 21 | Wed | | 78.3 | 45 | 78.3 | 131 | 2.4 | 80.7 |
| Feb 22 | Thur | | 78.0 | 45 | 78.0 | 122 | 2.7 | 80.7 |
| Feb 23 | Fri | | 77.5 | 45 | 77.5 | Landing Operations | NA | |
| Feb 24 | Sat | | 70.5 | | | | | |
| Feb 25 | Sun | | 68.9 | | | | | |
| Feb 26 | Mon | | 78.7 | 45 | 78.7 | 213 | .3 | 79.0 |
| Feb 27 | Tue | | 81.1 | 45 | 81.1 | 254 | - .5 | 80.6 |
| Feb 28 | Wed | | 77.5 | 45 | 77.5 | Landing Operations | NA | |
| Mar 1 | Thur | | 78.3 | 45 | 78.3 | 346 | 1.8 | 80.1 |
| Mar 2 | Fri | | 76.5 | 45 | 76.5 | 102 | 3.5 | 80.0 |

(1) From Eq. 1 or Other Information

(2) From Eq. 2

(3) From Tower Log Analysis

(4) Adjustment = $-10 \log \frac{\text{Effective No. of Oper.}}{\text{NOISEMAP}}$
 Effective No. of Oper.

Calculated

| Measurement Std. Deviation | Measurement DNL |
|----------------------------|-----------------|
| 27,285,659 | 80.6 |

90% CI = 81.2 to 80.0

FIG. 6c. Worksheet 1 for Site 4 at Laughlin AFB TX

Measurement Program _____ Sheet _____ of _____

Site Number _____ 2 _____

Engineer _____ Robert Lee _____

Date _____

| From Worksheet 9 | | | | | | | From Chart Fig. 11 | From Equation 1 |
|------------------|--------|------------|----------------|-----------------|--------------|------------------------|--------------------|-----------------------|
| Aircraft | Runway | Operation | Slant Distance | Elevation Angle | Aircraft SEL | Effective No. of Oper. | Variance | σ_i |
| T-38 | 13CA | Depart | 1635' | 37.3° | 100.3 | 137.1 | 1 | 3.80×10^{11} |
| T-38 | 13CG | Depart | 2029' | 50.2° | 100.6 | 41.8 | 3 | 2.34×10^{11} |
| T-38 | 13LD2 | Cross-wind | 1495' | 33.3° | 103.8 | 15.5 | 3 | 1.82×10^{11} |
| T-38 | 13LD1 | Cross-wind | 1866' | 31.0° | 101.3 | 16.2 | 3 | 1.07×10^{11} |
| T-38 | 13LH | Cross-wind | 1557' | 45.1° | 102.5 | 11.7 | 1 | 5.39×10^{10} |
| T-38 | 13LE1 | Cross-wind | 1570' | 45.5° | 102.3 | 12.1 | 1 | 5.32×10^{10} |
| T-38 | 13CE | Cross-wind | 1268' | 66.8° | 104.2 | 7.6 | 1 | 5.18×10^{10} |
| T-38 | 13LD3 | Closed | 4350' | 12.3° | 91.7 | 61.3 | 8 | 8.32×10^{10} |
| T-38 | 13LE2 | Closed | 3863' | 13.9° | 92.7 | 34.9 | 8 | 5.97×10^{10} |
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| | | | | | | | | |

NOISEMAP DNL _____ 75.9 _____

Calculated σ _____ 5,942,050 _____

90% c.i. $\left\{ \begin{array}{l} (+) \\ (-) \end{array} \right.$ _____ 76.3 _____

_____ 75.5 _____

FIG. 7a. Worksheet 5 for Site 2 at Laughlin AFB TX

Measurement Program _____ Sheet _____ of _____

| | |
|-------------|------------|
| Site Number | 4 |
| Engineer | Robert Lee |
| Date | |

| From Worksheet 9 | | | | | | | From Chart Fig. 11 | From Equation 1 |
|------------------|--------|------------|----------------|-----------------|--------------|------------------------|--------------------|-----------------------|
| Aircraft | Runway | Operation | Slant Distance | Elevation Angle | Aircraft SEL | Effective No. of Oper. | Variance | σ_i |
| T-38 | 13CA | Depart | 797' | 90 ° | 106.8 | 137.1 | 1 | 1.70×10^{12} |
| T-38 | 13CG | Depart | 1246' | 90 ° | 105.5 | 41.8 | 1 | 3.84×10^{11} |
| T-38 | 13LD2 | Cross-wind | 1308' | 32.8° | 105.0 | 15.5 | 3 | 2.40×10^{11} |
| T-38 | 13LD1 | Cross-wind | 1378' | 37.0° | 104.5 | 16.2 | 1 | 1.18×10^{11} |
| T-38 | 13CE | Cross-wind | 905' | 84.0° | 107.8 | 7.6 | 1 | 1.19×10^{11} |
| T-38 | 13LD3 | Closed | 2832' | 17.6° | 96.8 | 61.3 | 5 | 1.98×10^{11} |
| T-38 | 13LE1 | Cross-wind | 1421' | 39.3° | 103.6 | 12.1 | 1 | 7.18×10^{10} |
| T-38 | 13LH | Cross-wind | 1421' | 39.3° | 103.6 | 11.7 | 1 | 6.94×10^{10} |
| T-38 | 13LE2 | Closed | 2527' | 18.3° | 97.8 | 34.9 | 5 | 1.42×10^{11} |
| | | | | | | | | |
| | | | | | | | | |
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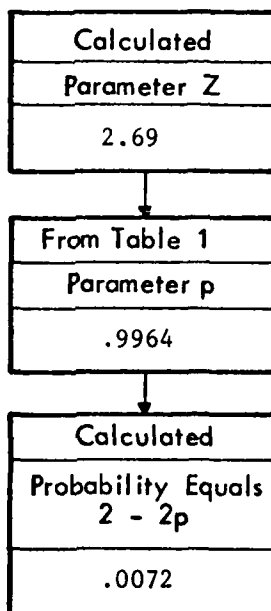
| | |
|---------------------|------------|
| NOISEMAP DNL | 81.0 |
| Calculated σ | 31,734,775 |
| 90% c.i. { (+) | 81.6 |
| (-) | 80.4 |

FIG. 7c. Worksheet 5 for Site 4 at Laughlin AFB TX

Measurement Program _____ Sheet _____ of _____

File Number 2
 Engineer Robert Lee
 Date _____

| From Worksheet | or Worksheet | From Worksheet | From NOISEMAP |
|-----------------------------------|-------------------------|--------------------------------|-----------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | <u>DNL(M)</u> or DNL(S) | σ_i | DNL(C) |
| 308,080 | 73.6 | 5,942,050 | 75.9 |



This Value is the Probability that the
 Measurements and the NOISEMAP
 Predictions are Consistent.
 (The Probability that they are not
 Consistent is 1 Minus this Value.)

FIG. 8a. Worksheet 6 for Site 2 at Laughlin AFB TX

Measurement Program _____ Sheet _____ of _____

File Number _____ 3 _____

Engineer _____ Robert Lee _____

Date _____

| From Worksheet or Worksheet | | From Worksheet | From NOISEMAP |
|--------------------------------|-------------------------|-----------------------------|---------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | <u>DNL(M)</u> or DNL(S) | σ_i | DNL(C) |
| 20,550,352 | 76.8 | 24,080,790 | 82.7 |

| |
|-------------|
| Calculated |
| Parameter Z |
| 4.37 |

| |
|--------------|
| From Table 1 |
| Parameter p |
| .9999 |

| |
|------------------------------|
| Calculated |
| Probability Equals 2 - 2p |
| .0002 |

This Value is the Probability that the Measurements and the NOISEMAP Predictions are Consistent.

(The Probability that they are not Consistent is 1 Minus this Value.)

FIG. 8b. Worksheet 6 for Site 3 at Laughlin AFB TX

Measurement Program _____ Sheet _____ of _____

File Number _____ 4 _____

Engineer _____ Robert Lee _____

Date _____

| From Worksheet | or Worksheet | From Worksheet | From NOISEMAP |
|-----------------------------------|-------------------------|--------------------------------|-----------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | <u>DNL(M)</u> or DNL(S) | σ_i | DNL(C) |
| 27,285,659 | 80.6 | 31,734,775 | 81.0 |

| |
|-------------|
| Calculated |
| Parameter Z |
| 0.26 |



| |
|--------------|
| From Table 1 |
| Parameter p |
| .6026 |



| |
|------------------------------|
| Calculated |
| Probability Equals 2 - 2p |
| .7948 |

This Value is the Probability that the
Measurements and the NOISEMAP
Predictions are Consistent.

(The Probability that they are not
Consistent is 1 Minus this Value.)

FIG. 8c. Worksheet 6 for Site 4 at Laughlin AFB TX

TABLE 1

REGROUPED RANK ORDERED LDN MAIN CONTRIBUTORS
AT LAUGHLIN AFB TX

| SITE | AIRCRAFT | FLIGHT TRANS | OPERATION | SEL | AV SLANT DISTANCE | EFFECTIVE OPS | PART DNL | RANK # | TOTAL DNL THROUGH RANK |
|------|----------|---|----------------------------|-------|----------------------|------------------|-------------|-----------|---------------------------|
| 2 | T-38 | 13CA1 13CAL 13CA3 13CG | Depart | 100.4 | 1750' | 178.9 | 73.5 | 1 | 73.5 |
| | | 13LD1 13LD2 13LH 13LE1 13CE | Crosswind | 103.0 | 1550' | 63.1 | 71.6 | 2 | 75.7 |
| | | 13LD3 13LE2 | Closed Loop | 92.2 | 4100' | 96.2 | 62.6 | 3 | 75.9 |
| | | | | | | | | | |
| 3 | T-38 | 13LD3 13LE2 | Closed Loop | 109.8 | 760' | 96.2 | 80.2 | 1 | 80.2 |
| | | 13LD2 13LD1 13LE1 13LH | Crosswind Left Runway | 109.3 | 825' | 55.5 | 77.3 | 2 | 82.0 |
| | | 13CA1 13CA2 13CA3 13CG | Depart | 100.9 | 1670' | 178.9 | 74.0 | 3 | 82.6 |
| | | | | | | | | | |
| 4 | T-38 | 13CA1 13CA2 13CA3 13CG | Depart | 106.5 | 900' | 178.9 | 79.6 | 1 | 79.6 |
| | | 13LD1 13LD2 13LH 13LE1 | Crosswind Left Runway | 104.2 | 1380' | 55.5 | 72.2 | 2 | 80.3 |
| | | 13LD3 13LE2 | Closed Loop | 97.3 | 2680' | 96.2 | 67.7 | 3 | 80.6 |
| | | 13CE | Crosswind Center Runway | 107.8 | 905' | 7.6 | 67.2 | 4 | 80.7 |

TABLE 2

MEASURED SELs AND ALTITUDES
AT LAUGHLIN AFB TX

| SITE | AIRCRAFT | OPERATION | SEL | | SLANT DISTANCE | | NOISEMAP | |
|------|----------|-----------------------|----------|----|----------------|--------|----------|------------|
| | | | MEASURED | # | AVE | PHOTOS | SEL | SLANT DIST |
| 2 | T-38 | Depart | 96.0 | 13 | 1368' | 5 | 100.4 | 1750' |
| | T-38 | Crosswind | 95.1 | 4 | 2025' | 5 | 103.0 | 1550' |
| | T-38 | Closed Loop | 90.5 | 22 | 3620' | 13 | 92.2 | 4100' |
| 3 | T-38 | Closed Loop | 105.1 | 1 | -- | -- | 109.8 | 760' |
| | T-38 | Crosswind | 95.2 | 1 | -- | -- | 109.3 | 825' |
| | T-38 | Left Runway Depart | 98.8 | 8 | -- | -- | 100.9 | 1670' |
| 4 | T-38 | Depart | 108.2 | 21 | 638' | 1 | 106.5 | 900' |
| | T-38 | Crosswind | 102.9 | 4 | 1965' | 2 | 104.2 | 1380' |
| | | Left Runway | | | | | | |
| | T-38 | Closed Loop | 98.8 | 18 | -- | -- | 97.3 | 2600' |
| | T-38 | Crosswind | No Data | -- | -- | -- | 107.8 | 905' |
| | | Center Runway | | | | | | |

IV. HOMESTEAD AFB STUDY

TEST PREPARATION

After the problems encountered at Laughlin AFB a less ambitious test was planned for Homestead AFB. Under the approach flight tracks at Homestead AFB was a PUD (Planned Urban Development) area that has area within the DNL 65 to 80 contours. See Figure 9. The purpose of this test is to help document the noise exposure for prevention against future encroachment. For this test a monitor was to be placed on either side of the PUD area directly under the flight tracks. The third monitor was to be placed in the middle of a highly suspect "bulge" in the contours located near a ground runup trim pad. This area was suspect because of the large amount of high power (military and afterburner) run time on trim pads 10 and 11 (the trim pads near the bulge).

Figure 10 shows the dominant input flight tracks and the measurement locations at Homestead AFB FL. All three monitors were to be left at the same locations for the duration of the test (2 weeks) to obtain a good statistical sampling of the daily DNL values (about 8-10 busy day DNLs can be obtained in a two week measurement).

Mr. Roland Allen in the Civil Engineering Office at Homestead was identified as our point of contact. A detailed test plan, AMRL/BBE-TP-32, was sent to him for coordination/information of the various base organizations that we would require support from, i.e., Base Commander, Director of Maintenance, Base Operations, etc. To help expedite getting the monitors out to start data collection, Mr. Allen went out and surveyed the area for specific sites to place our monitors and obtained permission to take measurements prior to the start of the test. This saved us several days of valuable data collection time. Also coordination was made with Base Operations to collect the traffic count on each flight track using their designation for each flight track. See Figure 2B. The tracks are identified as follows: VI is vector to intercept approach, PA is precision approach, SA is surveillance approach and TA is a TACAN approach. Other approaches that were used followed these basic tracks and are as follows: PSG is a precision shotgun approach and is used for two or three aircraft that come in on the SA track, ILS and ARA are an instrumented landing approach and airborne radar approach and follow the PA track and the VA is a visual approach that somewhat uses the VI track but does an overhead pass, pitch out and then lands. This left only the touch and go patterns and the pitch outs that were not being counted by Base Operations.

It was felt we could screen the events from Site 2 to Site 1 and attribute these events to the touch and go patterns so no attempt was made to task Base Operations with the added job of counting these events.

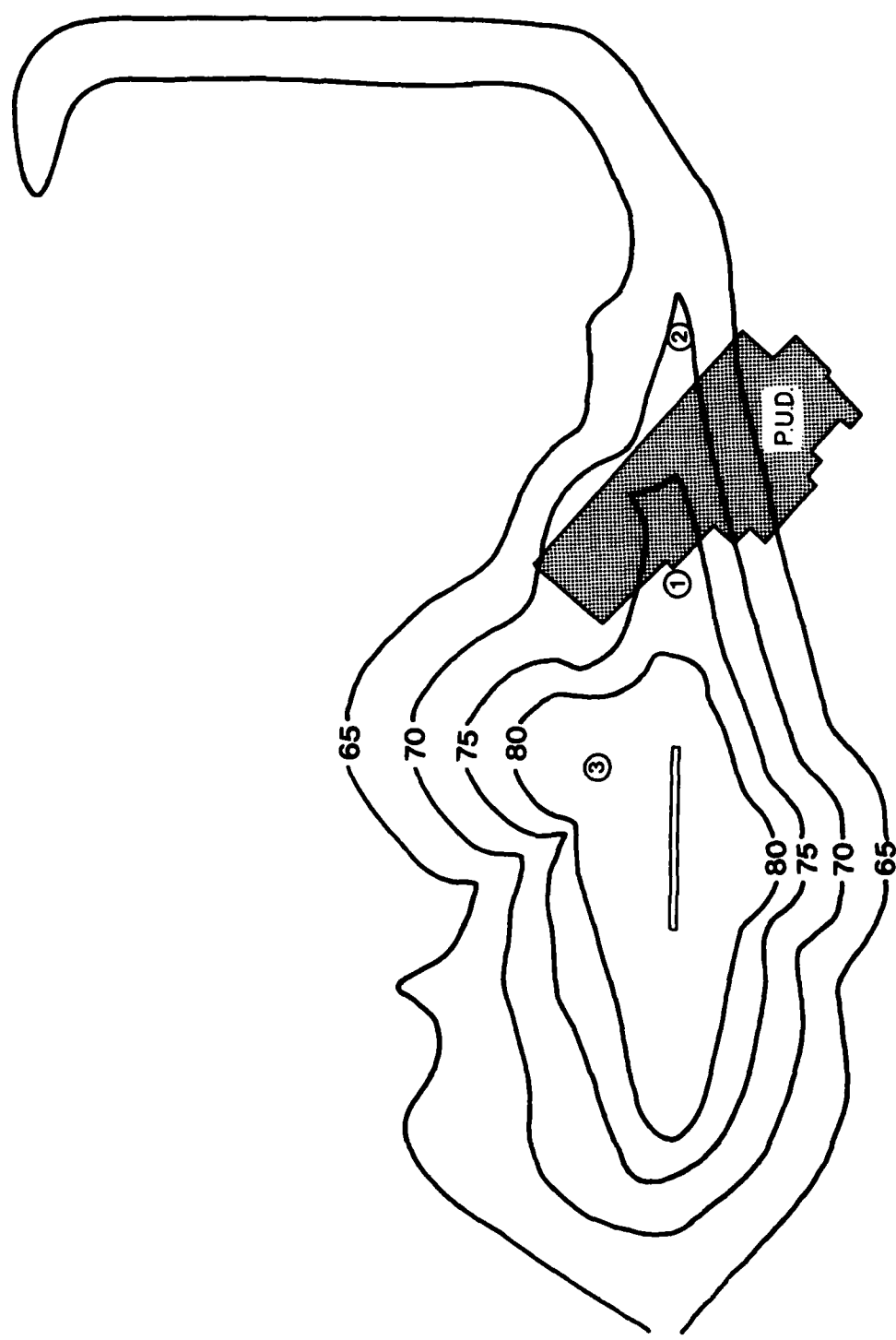


Figure 9. Planned Urban Development (PUD) and NOISECHECK Measurement Locations at Homestead AFB FL.

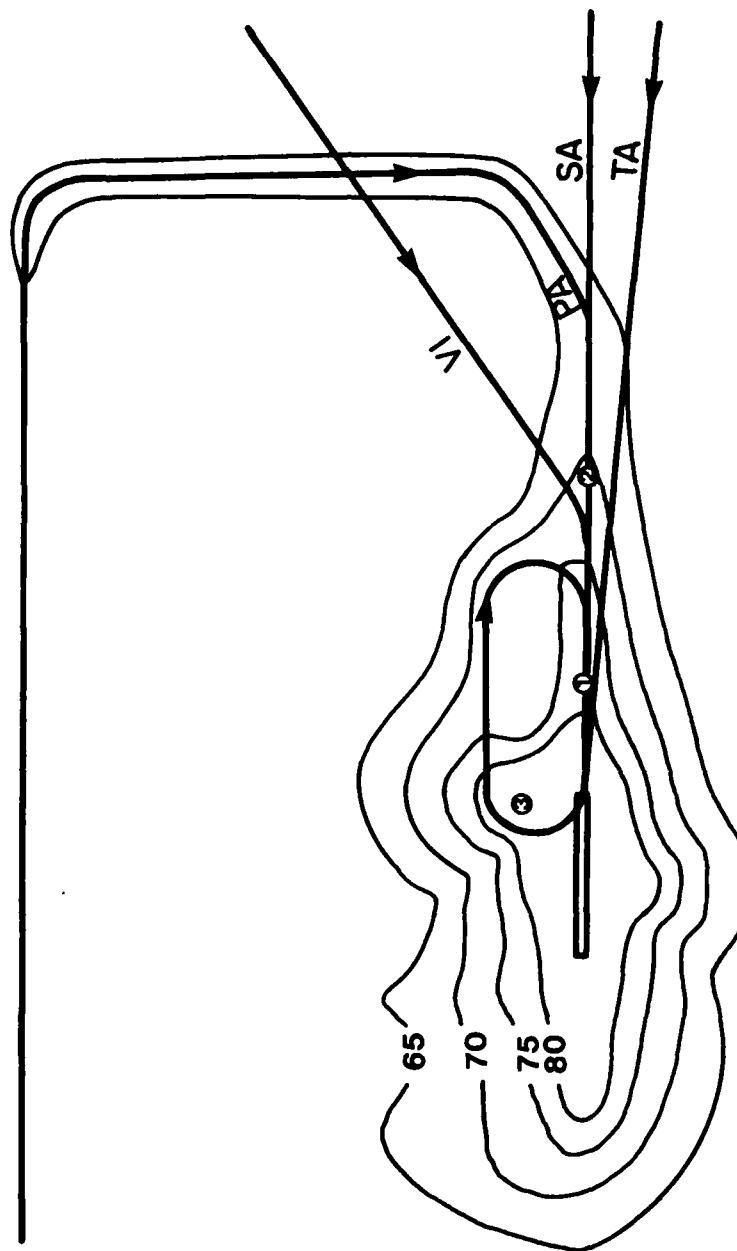


Figure 10. Dominant Flight Tracks at Homestead AFB FL

DATA COLLECTION AT HOMESTEAD AFB

Initial Setup

Things went relatively smoother at Homestead AFB. Our point of contact, Mr. Roland Allen, had previously scouted the proposed measurement locations and obtained permission for us to place our systems out at almost the exact locations in the proposed plan. This allowed us to get monitors up and running at locations 1 and 2, Monday, September 10th, the first day of our test period. The next day when servicing the monitors, the monitor at Site 1 malfunctioned with a complete power loss when the unit was opened. We replaced this monitor with the monitor for Site 3 and brought the malfunctioning unit back to the base. The power loss occurred because the clips from the battery to the disconnect point had fallen off. This was corrected by soldering the clips on to the battery terminals for this and the other units battery packs. (We recommend for anyone using the NOISECHECK units to solder these clips.) On September 13 we placed the third unit at Location 3. All the units were chained down with a chain wrapped around the case through the handle and locked to a tree or some other solid stanchion. Extra precaution was taken by placing the units behind brush and out of sight. But even so, the unit at Location 3 was stolen on September 18th and therefore no conclusive data is presented for the actual levels for the runway bulge area.

Collection of Acoustic and Weather Data

The NOISECHECK units were set to printout hourly noise levels (HNL), community noise levels (CNEL), day-night levels (DNL), and sound exposure levels (SEL) for the complete duration of the test. SELs were taken for the complete duration of the test at Homestead because all of the landing operations except pitchout maneuvers were being logged by Base Operations. With this information virtually every noise event that occurred at the monitors was identified. Table B-1 lists the HNLs, DNLs and CNELs collected from the monitors. Table B-2 lists the temperature and relative humidity during the test collected by Base Weather. The blocked-in area indicates when there was aircraft activity.

Collection of Aircraft Operations Information at Homestead AFB

The collection of aircraft operations was simpler at Homestead AF Base because most of the aircraft activity over our measurement positions was already being logged by Base Operations. Only two kinds of operations that occurred near our measurement locations, the pitchout landing and the November-Kilo takeoff, were not logged by Base Operations. To do a pitchout landing a plane coming in on a normal approach would veer to the right after passing the end of the runway and fly a complete race track before landing. Base Operations would log this as one normal approach even though the aircraft ground track would pass over Location 1 twice. November-Kilo was a code for

a takeoff scramble to the south. The aircraft would be low and at max power over Location 1 but high or veered to either side of Location 2. Since this occurred at random times on an alert or practice alert basis, it is not certain exactly how many occurred during our measurement period. These two unlogged events could have had an impact on the field measured DNL at Site 1 but probably had no impact at Site 2. Table B-3 lists the operations that were logged by Base Operations and the NOISEMAP flight tracks associated with each. Every one of these events were identified with a specific noise event recorded by our NOISECHECK units. Also included in this table is a comparison of the logged busy day operations with the NOISEMAP busy day operations by flight track.

Engine power setting, airspeed and aircraft altitude at the microphone locations were obtained by talking to the standard evaluation personnel at Homestead. Table B-4 lists the F-4 values for a standard approach which was flown on all the approach flight tracks. The T-38s were considered and measured as inconsequential to the total noise exposure metric DNL. Photographs were taken from the microphone locations with the aircraft at the point of closest approach to verify the slant distance to the aircraft. Table B-5 gives the summary from photographic scaling.

Determination of which aircraft/flight tracks that were significant at each location proved to be a very time consuming job even with the small number of aircraft/flight tracks that were at Homestead. This could be easily done by the NOISEMAP program itself and would provide the screening technique that is needed for determining the amount of operational data that is required at each location.

DATA ANALYSIS AT HOMESTEAD AFB

1. Direct Measurement DNL Analysis

To determine how much individual operations influence each measurement point we need to determine the major DNL contributors at those measurement points. At Homestead AFB, since the monitor at location three was stolen halfway through the survey, we will only look at the data for the two locations on either side of the PUD (Proposed Urban Development) area. The list of DNL contributors for each measurement location (Worksheet 9 from the NOISECHECK procedures) are presented in Figures 11a and 11b. The flight track descriptor tells what runway was used. Runway 05 is a landing over the measurement points and Runway 23 is a takeoff over the measurement points. From these worksheets we can see that on an average busy day these sites are not significantly affected by any of the T-38 operations or the F-4 takeoff operations with the possible exception of the straight out takeoffs on 23A. Site 1 is dominated by the four F-4 landing operations: vector to intercept with pitchout, surveillance approach, precision approach and touch-and-go pattern.

Site 2 is dominated by the F-4 precision approach and the surveillance approach. Figure 12 shows the effective number of dominant operations for an average busy day from the NOISEMAP inputs, the daily number of dominant operations from the tower count and the adjustment to be applied to the measured daily DNLs for each site. These adjustments are now input into the Worksheet 1s for each site (see Figures 13a and 13b). This worksheet then gives us the measurement DNL, the associated standard deviation and the 90% confidence intervals at each site. To compare these values with NOISEMAP we need to determine the NOISEMAP DNL, standard deviation and the 90% confidence intervals at each measurement location. Worksheets 14a and 14b give these values. Next we need to calculate the probability that the measured DNL and the NOISEMAP calculated DNL are consistent. Figures 15a and 15b (Worksheet 6s) give the probabilities for each location. The final results are summarized in the following table:

| Homestead AFB Measurement Sites | Measurement DNL DNL (M) | NOISEMAP DNL DNL (C) | Probability of Consistency |
|------------------------------------|----------------------------|-------------------------|-------------------------------|
| 1 | 77.6 | 79.6 | .1646 |
| 2 | 70.4 | 69.5 | .6950 |

This analysis tells us that there is very good agreement at Site 2 and a minimal agreement at Site 1. Yet at Site 1 there are close 90% confidence intervals around both the NOISEMAP and measurement values suggesting that some factor was skewing the results like a possible power setting cutback over this measurement point. Again, to find out the cause of this problem, we need a more detailed analysis using the SEL information collected by NOISECHECK.

2. Calculated DNL From Measured SEL Analysis At Homestead AFB, FL

The first step in synthesizing the DNL values from the SEL is to identify the operations that produced each individual SEL. At Homestead AFB, Base Operations kept track of every operation that occurred. By correlating the times from the aircraft logs with the times of events on the NOISECHECK units, the SELs for all the logged aircraft activity were identified. Figure 16 gives an example from the Sept 14 logs of this correlation. Next, we take these measured SELs and add them up on the next worksheet. Figures 17a and 17b show the completed Worksheet 3s for each measurement site. Now following the same procedures used in the measured DNL analyses, we add all the operations to obtain the DNL at each site and its 90% confidence interval (Figures 18a and 18b) and the probability of consistency with the NOISEMAP predicted values (Figures 19a and 19b). The following table shows the final results.

| Homestead AFB Measurement Sites | Synthesized DNL DNL (S) | NOISEMAP DNL DNL (C) | Probability of Consistency |
|------------------------------------|----------------------------|-------------------------|-------------------------------|
| 1 | 73.9 | 79.6 | .0050 |
| 2 | 67.5 | 69.5 | .5418 |

Although this SEL analysis has lowered the probability of consistency from the measured DNL analysis, we can now see what is causing the discrepancies. First looking at Site 1, NOISEMAP says the main contributors are flight tracks 05G1 (VI and Pitchout) and 05J1 (SA with a pitchout maneuver) with almost identical SEL of 109.7 and 109.5. The SELs for 05G1 are caused by the aircraft coming in on a normal landing glide slope then pitching out to the right before the end of the runway (after passing Site 1) then making a short loop and landing (passing over Site 1 again). Individually, this gives SEL values of 102.0 for the first pass and 108.9 for the second pass. While we were out at Site 1 we noticed that most of these pitchouts would circle well before Site 1, therefore never having a chance to add in the SEL of 108.9 expected by NOISEMAP to the total exposure measured in the field. Now the 05J1 (SA) approaches are slightly different. In NOISEMAP, they come over the Site 1 at a high altitude first, producing an SEL of 99.7 then pitching out and coming back over Site 1 at a lower altitude producing an SEL of 109.0. From our observations in the field, this maneuver was done as described in NOISEMAP. Another problem with the data at Site 1 was that for all the four landing operations NOISEMAP used the reference landing power setting in NOISEMAP of 87% RPM and 190 KTS. Standard evaluation personnel at Homestead said that the nominal power setting over Site 1 was 84% - 85% RPM and 160 knots. Using 84.5% as the average value these differences (airspeed and power setting) would cause NOISEMAP to overpredict the SEL values for all four landing operations by 1.7 dB. If we incorporate these two differences (short turn for VI and 84.5% RPM power at 160 knots) into the NOISEMAP program, it would produce a value of 74.9 LDN. Following through the rest of the equations on the worksheets, we get the following values:

| Operation | SEL | Effective No. of Operations | Variance | i |
|-----------|-------|--------------------------------|----------|-----------------------|
| VI | 102.0 | 25.71 | 1 | 1.06×10^{11} |
| SA | 107.8 | 18.38 | 1 | 2.87×10^{11} |
| PA | 106.8 | 22.42 | 1 | 2.78×10^{11} |
| TA | 103.3 | 4.43 | 3 | 4.64×10^{10} |

This gives us a σ_c of 4.81×10^6 and a 90% confidence interval of 74.3 to 75.4. This then gives us values of $Z = .295$, $P = .6160$ and a probability of consistency of .7680. Also at Site 1 our measurements of slant distance to the aircraft (approximately 630 ft.) were consistently higher than the NOISEMAP slant distances (approximately 530 ft.). This would cause our measured SEL to be approximately 1.5 dB lower than the NOISEMAP prediction. Although this would bring the measurements and NOISEMAP values closer together, I did not include the larger slant distance in recomputing the NOISEMAP values. This was because standard evaluation personnel claimed that the average height over this measurement location was close to what was already input to NOISEMAP and not the 630 ft. that I measured.

At Site 2 we had fairly good agreement between measured and NOISEMAP values but the probability of consistency of .5418 reflects the 2 dB separation between the two values. But again looking at the main contributors at this site, we find one of the same problems. Here all the flight tracks were being flown as indicated in NOISEMAP but the power settings and airspeeds that were input to NOISEMAP were the reference 87% RPM and 190 KTS. Again, the standard evaluation personnel at Homestead AFB told us that over Site 2 the F-4, on approach, would be between 83% and 87% RPM and between 230 KTS and 160 KTS. Standard evaluations altitude again agreed with the NOISEMAP input and was within 8% of our measured value. If we incorporate this one difference (85.5% RPM and 195 KTS, the mean values from standard evaluation) into the NOISEMAP program, it would produce an LDN value of 67.9. Following through the rest of the equations on the worksheets, we get the following values:

| Operation | SEL | Effective No. Of Operation | Variance | i |
|-----------|-------|-------------------------------|----------|-----------------------|
| PA | 102.0 | 22.42 | 1 | 9.20×10^{10} |
| SA | 98.3 | 28.38 | 1 | 3.22×10^{10} |
| VI | 91.8 | 25.71 | 8 | 3.57×10^{10} |
| TA | 97.2 | 4.43 | 3 | 1.14×10^{10} |

This gives us a σ_c of 1.21×10^6 and a 90% confidence interval of 67.2 to 68.6. This then gives us values of $Z = .1035$, $P = .5412$ and a probability of consistency of .9176. The following table summarizes the results of correcting these input errors to NOISEMAP.

| Homestead AFB Measurement Sites | Synthesized DNL DNL(S) | NOISEMAP DNL DNL(C) | Probability of Consistency |
|------------------------------------|---------------------------|------------------------|-------------------------------|
| 1 | 73.9 | 74.9 | .7680 |
| 2 | 67.5 | 67.9 | .9176 |

At Homestead AFB the average temperature and relative humidity for the measurement period when there were aircraft operations was 83°F and 75% relative humidity. To normalize the measured SELs to the standard day weather (59°F and 70% relative humidity) used in NOISEMAP we have to add 0.5 dB to the SELs at Site 2 and 0.4 dB to the SELs at Site 1. These offsets carry straight through in the DNL computations to give us values of 74.3 DNL for Site 1 and 68.0 DNL for Site 2. Assuming the scatter in the data remained the same, the results of the weather adjustments are summarized in the following table.

| HOMESTEAD AFB MEASUREMENT SITES | SYNTHESIZED DNL DNL(S) | NOISEMAP DNL DNL(C) | PROBABILITY OF CONSISTENCY |
|------------------------------------|---------------------------|------------------------|-------------------------------|
| 1 | 74.3 | 74.9 | .8532 |
| 2 | 68.0 | 67.9 | .9780 |

| | |
|-------------|------------|
| Site Number | 1 |
| Engineer | Robert Lee |
| Date | |

| From Worksheet 8 | | | | | |
|------------------|---------------|---------|--------------|----------------|------------------|
| Aircraft | Operation | Flt Trk | Aircraft SEL | Day Operations | Night Operations |
| F-4 | VI & Pitchout | 05G1 | 109.7* | 25.71 | 0 |
| F-4 | SA | 05J1 | 109.5* | 18.38 | 0 |
| F-4 | PA | 05E1 | 108.5 | 20.02 | .24 |
| F-4 | T&G | 05I1 | 109.0 | 19.88 | 0 |
| F-4 | T10 | 23A | 111.9 | 1.53 | .02 |
| F-4 | T10 | 23B | 111.9 | 1.12 | .01 |
| F-4 | TA | 05F1 | 105.0 | 4.13 | .03 |
| F-4 | T10 | 23C | 111.9 | .77 | 0 |
| T-38 | PA | 05E6 | 95.1 | 1.88 | 0 |
| F-4 | | 23I1 | 96.8 | 1.12 | 0 |
| T-38 | VI & Pitchout | 05G4 | 95.8* | .55 | 0 |
| T-38 | SA | 05J4 | 95.8* | .26 | 0 |
| F-4 | | 23J | 87.9 | 1.14 | 0 |
| T-38 | TA | 05F3 | 91.7 | .32 | 0 |
| T-38 | | 23C | 94.1 | .14 | 0 |
| T-38 | T&G | 05I3 | 85.5 | .09 | 0 |
| T-38 | | 23J | 79.6 | .03 | 0 |
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Use
Equations
in
Supple-
ment

| Calculated | | | |
|---------------------------------|-------------|-------------|------------------------|
| Effective Numbers of Operations | Partial DNL | Rank Number | Total DNL Through Rank |
| 25.71 | 74.41 | 1 | 74.4 |
| 18.38 | 72.73 | 2 | 76.7 |
| 22.42 | 72.61 | 3 | 78.1 |
| 19.88 | 72.58 | 4 | 79.2 |
| 1.73 | 64.88 | 5 | 79.3 |
| 1.22 | 63.36 | 6 | 79.4 |
| 4.43 | 62.06 | 7 | 79.5 |
| .77 | 61.36 | 8 | 79.6 |
| 1.88 | 48.44 | 9 | 79.6 |
| 1.12 | 47.89 | 10 | 79.6 |
| .55 | 43.80 | 11 | 79.6 |
| .26 | 40.55 | 12 | 79.6 |
| 1.14 | 39.07 | 13 | 79.6 |
| .32 | 37.35 | 14 | 79.6 |
| .14 | 36.16 | 15 | 79.6 |
| .09 | 25.64 | 16 | 79.6 |
| .03 | 14.97 | 17 | 79.6 |
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*Addition of SELs due to aircraft passing over site twice.

FIG. 11a. Step-by-step Estimation of the Relative Importance of Operations at Site 1 at Homestead AFB FL

| Date | Daily Dominant Ops | | Adjustment to Ave Busy Day Ops | |
|---------|----------------------|--------|--------------------------------|--------|
| | Site 1 | Site 2 | Site 1 | Site 2 |
| Sept 11 | 86 | 27 | 0 | 1.8 |
| 12 | Takeoffs on this day | | - | - |
| 13 | Takeoffs on this day | | - | - |
| 14 | 75 | 60 | 0.6 | -1.7 |
| 15 | Saturday | | - | - |
| 16 | Sunday | | - | - |
| 17 | 49 | 39 | 2.5 | 0.2 |
| 18 | 64 | 38 | 1.3 | 0.2 |
| 19 | 79 | 57 | 0.4 | -1.5 |
| 20 | 70 | 56 | 0.9 | -1.4 |
| 21 | 65 | 46 | 1.2 | -0.5 |

NOTE: ILS and PSG (Precision Shotgun) approaches were counted under precision approaches for both sites. Effective number of operations for NOISEMAP.

SITE 1 Flt Tracks 05G1, 05J1, 05E1 and 05I1 = 86.4

SITE 2 Flt Tracks 05E1 and 05J1 = 40.8

Fig. 12. Adjustment For Measurement DNL To
Average Busy Day Operations at
Homestead AFB FL

Site Number _____ 1 _____
 Engineer _____ Robert Lee _____
 Date _____

| Date | Day of Week | From Paper Tape | | Bgnd. DNL (1) | DNL' (2) | Effective No. of Oper. (3) | No. Adj. (4) | Adj. DNL |
|---|-------------|-----------------|-------------------|---------------------|-------------|-------------------------------------|--------------------|-------------|
| | | Day No. | Meas. DNL | | | | | |
| Sep 11 | Tue | | 79.0 | 55 | 79.0 | 86 | 0 | 79.0 |
| 12 | Wed | | 76.2 ¹ | 55 | 76.2 | Takeoff Operations | | |
| 13 | Thur | | 75.7 ¹ | 55 | 75.7 | Takeoff Operations | | |
| 14 | Fri | | 75.3 | 55 | 75.3 | 75 | 0.6 | 75.9 |
| 15 | Sat | | 74.2 | 55 | | | | |
| 16 | Sun | | 65.9 | 55 | | | | |
| 17 | Mon | | 72.9 | 55 | 72.9 | 49 | 2.5 | 75.4 |
| 18 | Tue | | 78.3 | 55 | 78.3 | 64 | 1.3 | 79.6 |
| 19 | Wed | | 77.1 | 55 | 77.1 | 79 | 0.4 | 77.5 |
| 20 | Thur | | 75.2 | 55 | 75.2 | 70 | 0.9 | 76.1 |
| 21 | Fri | | 76.8 | 55 | 76.8 | 65 | 1.2 | 78.0 |
| | | | | | | | | |
| | | | | | | | | |
| 1 MISSING HNL WERE RECONSTRUCTED FROM Δ OF SITE 2 | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

(1) From Eq. 1 or Other Information

(2) From Eq. 2

(3) From Tower Log Analysis

(4) Adjustment = $-10 \log \frac{\text{Effective No. of Oper.}}{\text{NOISEMAP}}$
 Effective No. of Oper.

| Calculated | |
|-------------------------------|--------------------|
| Measurement Std. Deviation | Measurement DNL |
| 21,591,164 | 77.6 |

90% CI = 75.6 to 79.0

FIG 13a. Worksheet 1 for Site 1 at Homestead AFB FL

Measurement Program _____ Sheet _____ of _____

Site Number 2

Engineer Robert Lee

Date _____

| Date | Day of Week | From Paper Tape | | Bkgrnd. DNL (1) | DNL' (2) | Effective No. of Oper. (3) | No. Adj. (4) | Adj. DNL |
|---|-------------|-----------------|-------------------|-----------------|----------|----------------------------|--------------|----------|
| | | Day No. | Meas. DNL | | | | | |
| Sep 11 | Tue | | 69.6 | 55 | 69.6 | 27 | 1.8 | 71.4 |
| 12 | Wed | | 69.0 | 55 | 69.0 | Takeoff Operations | | |
| 13 | Thur | | 68.9 | 55 | 68.9 | Takeoff Operations | | |
| 14 | Fri | | 70.8 | 55 | 70.8 | 60 | -1.7 | 69.1 |
| 15 | Sat | | 67.0 | 55 | | | | |
| 16 | Sun | | 61.6 | 55 | | | | |
| 17 | Mon | | 70.7 | 55 | 70.7 | 39 | 0.2 | 70.9 |
| 18 | Tue | | 71.9 ² | 55 | 71.9 | 38 | 0.2 | 72.1 |
| 19 | Wed | | 72.4 | 55 | 72.4 | 57 | -1.5 | 70.9 |
| 20 | Thur | | 69.7 | 55 | 69.7 | 56 | -1.4 | 68.3 |
| 21 | Fri | | 69.0 | 55 | 69.0 | 46 | -0.5 | 68.5 |
| | | | | | | | | |
| | | | | | | | | |
| 2 CORRECTED FOR TRUCK IDLING BY MICROPHONE NEAR MIDNIGHT. | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

(1) From Eq. 1 or Other Information

(2) From Eq. 2

(3) From Tower Log Analysis

(4) Adjustment = $-10 \log \frac{\text{Effective No. of Oper.}}{\text{NOISEMAP Effective No. of Oper.}}$

| Calculated | |
|----------------------------|-----------------|
| Measurement Std. Deviation | Measurement DNL |
| 3,652,593 | 70.4 |

90% CI = 68.6 to 71.6

FIG. 13b. Worksheet 1 for Site 2 at Homestead AFB FL

WORKSHEET 5

CALCULATION OF THE NOISEMAP CONFIDENCE
INTERVALS AND STANDARD DEVIATION

Measurement Program _____ Sheet _____ of _____

Site Number 1
Engineer Robert Lee
Date _____

| From Worksheet 9 | | | | | | | From Chart Fig. 7 | From Equation 1 |
|------------------|--------|------------------|-------------------|--------------------|-----------------|------------------------------|-------------------------|-----------------------|
| Aircraft | Runway | Operation | Slant Distance | Elevation Angle | Aircraft SEL | Effective No. of Oper. | Variance | σ_i |
| F-4 | 05G1 | VI & Pitchout | 499' | 90° | 109.7 | 25.71 | 1 | 6.20×10^{11} |
| F-4 | 05J1 | SA | 493' | 90° | 109.5 | 18.38 | 1 | 4.24×10^{11} |
| F-4 | 05E1 | PA | 536' | 90° | 108.5 | 22.42 | 1 | 4.11×10^{11} |
| F-4 | 05I1 | T&G | 494' | 90° | 109.0 | 19.88 | 1 | 4.09×10^{11} |
| F-4 | 23A | T10 | 1500' | 90° | 111.9 | 1.73 | 1 | 6.94×10^{10} |
| F-4 | 23B | T10 | 1500' | 90° | 111.9 | 1.22 | 1 | 4.89×10^{10} |
| F-4 | 05F1 | TA | 964' | 28° | 105.0 | 4.43 | 3 | 6.87×10^{10} |
| F-4 | 23C | T10 | 1500' | 90° | 111.9 | .77 | 1 | 3.09×10^{10} |
| | | | | | | | | |
| | | | | | | | | |
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| | | | | | | | | |

NOISEMAP DNL 79.6
Calculated σ 11,060,722
90% c.i. $\left\{ \begin{array}{l} (+) \\ (-) \end{array} \right.$ 79.9
79.3

Fig. 14a. Worksheet 5 for Site 1 at Homestead AFB FL

CALCULATION OF THE NOISEMAP CONFIDENCE INTERVALS AND STANDARD DEVIATION

Site Number 2

Engineer Robert Lee

Date _____

| | |
|---------------------|-----------|
| NOISEMAP DNL | 69.5 |
| Calculated σ | 1,710,730 |
| 90% c.i. { (+) | 70.0 |
| (-) | 68.9 |

53

WORKSHEET 6

Measurement Program _____ Sheet _____ of _____

Site Number _____ 1 _____

Engineer _____ Robert Lee _____

Date _____

| From Worksheet 1 or Worksheet 4 | From Worksheet 5 | From NOISEMAP |
|-----------------------------------|-------------------------|--------------------------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation |
| σ_S or σ_M | <u>DNL(M)</u> or DNL(S) | σ_i |
| 3,652,593 | 70.4 | 1,710,730 |
| | | 69.5 |

| |
|-------------|
| Calculated |
| Parameter Z |
| .51 |

| |
|--------------|
| From Table 1 |
| Parameter p |
| .6950 |

| |
|------------------------------|
| Calculated |
| Probability Equals 2 - 2p |
| .6100 |

This Value is the Probability that the
Measurements and the NOISEMAP
Predictions are Consistent.

(The Probability that they are not
Consistent is 1 Minus this Value.)

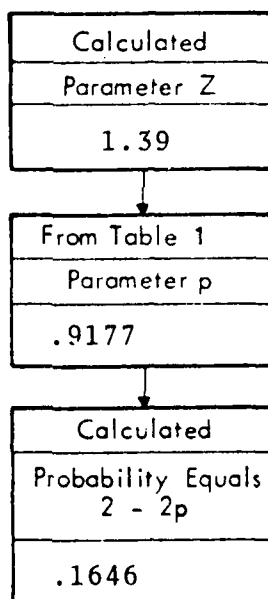
Fig. 15a. Worksheet 6 for Site 1 at Homestead AFB FL

WORKSHEET 6

Measurement Program _____ Sheet _____ of _____

| | |
|-------------|------------|
| Site Number | 2 |
| Engineer | Robert Lee |
| Date | |

| From Worksheet 1 or Worksheet 4 | | From Worksheet 5 | From NOISEMAP |
|---------------------------------|-------------------------|-----------------------------|---------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | <u>DNL(M)</u> or DNL(S) | σ_i | DNL(C) |
| 21,591,164 | 77.6 | 11,060,722 | 79.6 |



This Value is the Probability that the Measurements and the NOISEMAP Predictions are Consistent.

(The Probability that they are not Consistent is 1 Minus this Value.)

Fig. 15b. Worksheet 6 for Site 2 at Homestead AFB FL

| BASE OPERATIONS LOG | | | SITE 1 | | SITE 2 | | |
|------------------------|-------|--------------|--------|-------|---------------------------|-------|-------|
| Event | Time | Time | SEL | AL | Time | SEL | AL |
| 1 C-130 PA | 03:31 | Not Recorded | | | Not Recorded | | |
| 1 F-4 TA | 09:41 | 9:48:00 | 109.5 | 105.7 | 9:48:31 | 97.9 | 90.5 |
| 1 F-4 SA | 09:58 | 9:57:07 | 107.3 | 102.2 | 9:57:36 | 105.2 | 100.0 |
| 1 F-4 SA | 10:08 | 10:06:25 | 107.5 | 103.6 | 10:06:56 | 91.6 | 84.0 |
| 3 F-4 VI | 10:08 | 10:08:24 | 101.2 | 94.8 | 10:09:18 | 100.8 | 94.1 |
| 1 F-4 PA | 10:17 | 10:15:23 | 105.4 | 100.7 | 10:15:56 | 102.8 | 97.0 |
| 1 F-4 PA | 10:25 | 10:24:18 | 107.6 | 103.3 | 10:24:52 | 103.4 | 94.6 |
| 1 F-4 PA | 10:35 | 10:33:19 | 105.9 | 101.8 | 10:33:51 | 100.1 | 92.6 |
| 1 F-4 PA | 10:37 | 10:42:11 | 106.3 | 100.3 | 10:42:41 | 101.8 | 95.7 |
| 2 F-4 VI | 10:45 | 10:45:43 | 100.5 | 93.5 | 10:46:37 | 93.6 | 86.2 |
| 1 F-4 SA | 10:52 | 10:52:04 | 91.4 | 84.2 | 10:52:36 | 95.8 | 87.8 |
| 1 F-4 PA | 11:01 | 10:59:48 | 107.1 | 102.4 | 11:00:17 | 93.3 | 96.0 |
| 1 F-4 PA | 11:14 | 11:12:25 | 98.4 | 92.4 | 11:12:54 | 100.0 | 94.8 |
| 1 F-4 PA | 11:16 | 11:14:04 | 97.4 | 91.0 | 11:14:33 | 97.8 | 89.5 |
| 1 F-4 PA | 11:32 | 11:31:08 | 109.4 | 104.0 | 11:31:39 | 99.7 | 94.5 |
| 2 F-4 PA | 11:36 | 11:34:27 | 101.0 | 94.5 | 11:34:53 | 94.5 | 87.7 |
| | | 11:39:44 | 91.8 | 86.8 | 11:35:11 | 77.7 | 72.3 |
| 1 F-4 SA | 11:43 | 11:40:49 | 99.1 | 93.2 | 11:41:20 | 104.5 | 97.1 |
| 3 F-4 PSG | 11:46 | 11:42:05 | 91.2 | 85.0 | Recorded At the Same Time | | |
| | | 11:44:52 | 90.0 | 83.5 | | | |
| | | 11:45:16 | 99.3 | 92.5 | | | |
| 1 F-4 SA | 11:51 | 11:49:59 | 107.9 | 102.6 | 11:50:30 | 90.1 | 81.0 |
| 1 F-4 SA | 11:59 | 11:58:58 | 107.5 | 102.6 | 11:59:30 | 107.4 | 100.3 |
| 2 F-4 VI | 12:08 | 12:10:38 | 95.2 | 89.6 | Not Recorded | | |
| 1 F-4 SA | 12:13 | 12:11:58 | 108.0 | 102.3 | 12:12:28 | 106.2 | 99.0 |

Fig. 16. Event Correlation For Sept 14 Logs At
Homestead AFB

Measurement Date 11-21 Sept

Fig. 17a. Worksheet 3 for Site 1 at Homestead AFB FL

Site Number 2
Engineer Robert Lee
Measurement Date 11 - 21 Sept

[illegible]

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Measurement Program _____ Sheet _____ of _____

Site Number 1
 Engineer Robert Lee
 Measurement Date 11 - 21 Sept

| Flight Track | A/C | Oper. | Adj. SEL _i | N _i | n _i | σ _i |
|--------------|-----|-------|-----------------------|----------------|----------------|-----------------------|
| 05E1 | F-4 | PA | 104.3 | 22.42 | 257 | 3.06x10 ¹⁰ |
| 05J1 | F-4 | SA | 107.4 | 18.38 | 46 | 7.49x10 ¹⁰ |
| 05F1 | F-4 | TA | 102.9 | 4.43 | 23 | 2.17x10 ¹⁰ |
| 05G1 | F-4 | VI | 102.5 | 25.71 | 105 | 3.71x10 ¹⁰ |
| | | | | | | |
| | | | | | | |
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| | | | | | | |

From Equations in Supplement

| | |
|------------|------------------------------|
| DNL | <u>73.9</u> |
| σ | <u>2.10 x 10⁷</u> |
| 90% c.i. { | (+) <u>76.2</u> |
| | (-) <u>68.8</u> |

Fig. 18a. Worksheet 4 for Site 1 at Homestead AFB FL

Measurement Program _____ Sheet _____ of _____

Site Number 2

Engineer Robert Lee

Measurement Date 11 - 21 Sept

| Flight Track | A/C | Oper. | Adj. SEL _i | N _i | n _i | σ _i |
|--------------|-----|-------|-----------------------|----------------|----------------|-------------------------|
| 05E1 | F-4 | PA | 100.3 | 22.42 | 242 | 1.4982x10 ¹⁰ |
| 05J1 | F-4 | SA | 98.8 | 18.38 | 33 | 1.3860x10 ¹⁰ |
| 05F1 | F-4 | TA | 96.5 | 4.43 | 14 | 6.8245x10 ⁹ |
| 05G1 | F-4 | VI | 95.4 | 25.71 | 117 | 4.8693x10 ⁹ |
| | | | | | | |
| | | | | | | |
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From Equations in Supplement

| | |
|------------|------------------------------|
| DNL | <u>67.5</u> |
| σ | <u>5.10 x 10⁶</u> |
| 90% c.i. { | (+) <u>69.9</u> |
| | (-) <u>61.6</u> |

Fig. 18b. Worksheet 4 for Site 2 at Homestead AFB FL

WORKSHEET 6

CALCULATE THE PROBABILITY THAT
THE DNL FROM MEASUREMENTS AND
THE DNL FROM NOISEMAP ARE
CONSISTENT

Measurement Program _____ Sheet _____ of _____

Site Number 1

Engineer Robert Lee

Date _____

| From Worksheet 3 or Worksheet 6 | | From Worksheet 4 | From NOISEMAP |
|-----------------------------------|-------------------------|--------------------------------|-----------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | DNL(M) or <u>DNL(S)</u> | σ_i | DNL(C) |
| 2.10×10^7 | 73.9 | 1.11×10^7 | 79.6 |

| |
|-------------|
| Calculated |
| Parameter Z |
| 2.81 |

| |
|--------------|
| From Table 1 |
| Parameter p |
| .9975 |

| |
|--------------------------------|
| Calculated |
| Probability Equals $2 - 2p$ |
| .0050 |

This Value is the Probability that the
Measurements and the NOISEMAP
Predictions are Consistent.

(The Probability that they are not
Consistent is 1 Minus this Value.)

Fig. 19a. Worksheet 6 for Site 1
at Homestead AFB FL

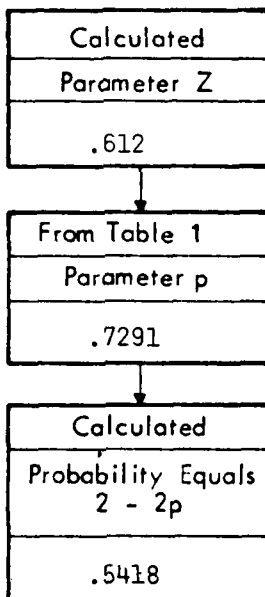
WORKSHEET 6

CALCULATE THE PROBABILITY THAT
THE DNL FROM MEASUREMENTS AND
THE DNL FROM NOISEMAP ARE
CONSISTENT

Measurement Program _____ Sheet _____ of _____

Site Number 2
Engineer Robert Lee
Date 11 - 21 Sept

| From Worksheet 3 or Worksheet 6 | | From Worksheet 4 | From NOISEMAP |
|-----------------------------------|-------------------------|--------------------------------|-----------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | DNL(M) or <u>DNL(S)</u> | σ_i | DNL(C) |
| 5.10×10^6 | 67.5 | 1.71×10^6 | 69.5 |



This Value is the Probability that the
Measurements and the NOISEMAP
Predictions are Consistent.

(The Probability that they are not
Consistent is 1 Minus this Value.)

Fig. 19b. Worksheet 6 for Site 2
at Homestead AFB FL

V. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

In summary, the NOISECHECK units operated without problems once we started using the desiccants to keep the moisture out. The units are simple to use and operate. At Laughlin AFB a person was trained to service and calibrate the units in a couple of hours. Security for the units was a problem (one unit was stolen at Homestead AFB) even when the units were chained down. This is always going to remain a problem because there will be times when you will need to monitor in unsecured areas.

These two tests underscore the necessity of obtaining detailed information on only the right operations. This can only be done if the main contributors to the DNL for each site have been identified prior to the test. At Laughlin we tried to identify all the events and ended up with too much information about events that didn't matter and too little information about events that did. This allowed us to make an overall DNL analysis but we couldn't resolve the differences with NOISEMAP. At Homestead AFB we had the right information and we could very easily resolve the measurement differences with NOISEMAP.

In the final analysis, NOISECHECK does provide the capability to spot-check the NOISEMAP predicted values. The equipment works well in very extreme weather conditions. The procedures are straight forward, although complicated, and do produce a single number to tell how close the measurements and NOISEMAP agree that is understandable in normal statistical language. The worksheets are helpful but could be condensed and the SEL analysis makes it easy to identify precisely which operations, if any, are causing a deviation from the NOISEMAP values.

RECOMMENDATIONS

One of the biggest problems with acquiring the NOISECHECK data is the security for the systems. My first recommendation is whenever the NOISECHECK Units have to be placed in an exposed and unattended area that special security boxes be used. Figure 20 gives a diagram of what they should look like. The main features of these boxes are the auger that holds it down from the inside and the bars around the padlock. The auger makes it hard for someone or even several people to just pick up the unit and walk away. The bars around the padlock prevent anyone from using bolt cutters to cut the lock off. If made of a heavy gauge steel, the boxes will also prevent most vandalism from destroying the units.

The biggest problem with preparing for a survey is sorting through the NOISEMAP chronicles to determine the major contributors at each point. My second recommendation is to develop a subroutine

for the NOISEMAP program, that would list out the information on each aircraft/flight track/operation for a specified ground location. The program would also rank order this information by its LDN contribution to the selected location. The subroutine should be able to handle about ten locations and print out the information in the format laid out in Figure 21. Each printout page would be a summary analysis of each location and could be directly input into the NOISECHECK analysis. This would become the cornerstone of the NOISECHECK program for two reasons. 1. It would provide a way to check the NOISEMAP inputs at a specific location prior to undertaking an expensive NOISECHECK test, and 2. It would be the screening device needed to concentrate the data collection efforts on only the events that are important to each location. I estimate that this subroutine could cut the amount of time and effort to do an adequate NOISECHECK study in half. This would streamline and simplify the whole NOISECHECK technology making it easier to comprehend when the cases do go to court.

NOISE MONITOR SECURITY

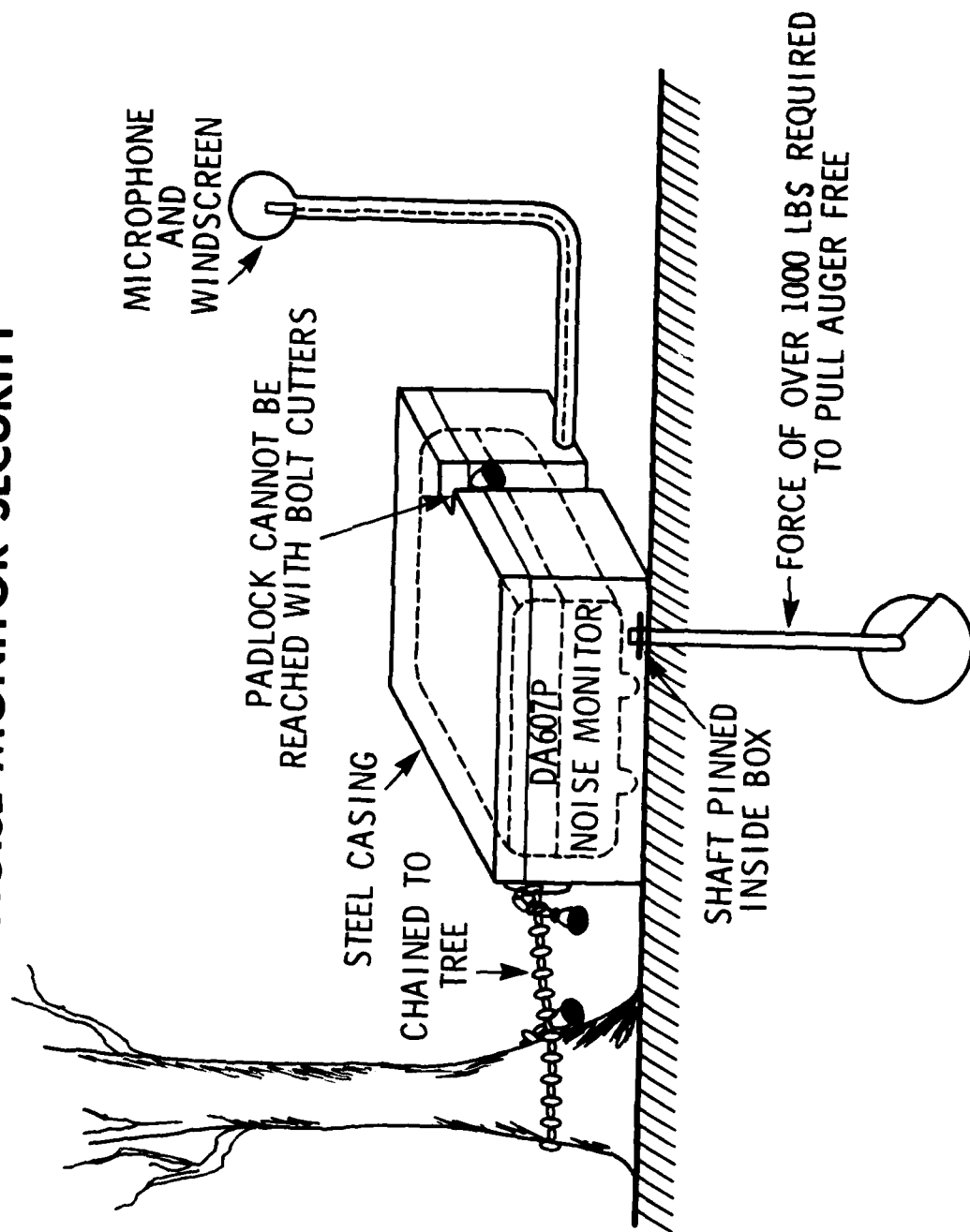


Figure 20. Proposed Noise Security Cases

Site Number _____ Site Location _____ ° ' " _____ Date Run _____
 _____ ° ' " _____

| A/C | Flt Trk | Power Setting | Airspeed | ALT | Slant Distance | Elevation Angle | No of Events Day Night | SEL | LDN _i | Rank | Total DNL | Variance* | σ _i ** |
|-----|---------|---------------|----------|-----|----------------|-----------------|--------------------------|-----|------------------|------|-----------|-----------|-------------------|
| | | | | | | | | | | 1 | | | |
| | | | | | | | | | | 2 | | | |
| | | | | | | | | | | 3 | | | |
| | | | | | | | | | | 4 | | | |
| | | | | | | | | | | 5 | | | |
| | | | | | | | | | | 6 | | | |
| | | | | | | | | | | 7 | | | |
| | | | | | | | | | | 8 | | | |
| | | | | | | | | | | 9 | | | |
| | | | | | | | | | | 10 | | | |

* Variance is from Figure D-6 in Appendix D

$$** \sigma_i = N_i \left[\text{antilog} (SEL_i + \sqrt{\text{variance}_i}) / 10 - \text{antilog} (SEL_i / 10) \right]$$

$$\sigma_c = \frac{\sqrt{\sum_{i=1}^N \sigma_i^2}}{86,400}$$

$$90\% \text{ CI} = 10 \log \left[\text{antilog}(DNL(c)/10 \pm 1.645 \sigma_c / \sqrt{1}) \right]$$

DNL(c) _____
 σ_c _____
 90% CI { ± _____

Fig. 21. LDN_i Summary Sheet

APPENDIX A

LAUGHLIN AFB DATA

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Hour | Wednesday, Feb 14 | | | | | Thursday, Feb 15 | | | | |
|------|-------------------|--------|--------|--------|-----------|------------------|--------|--------|--------|-----------|
| | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | | | | Takeoffs | 29.7 | | | 32.3 | Takeoffs |
| 2 | | | | | | 29.7 | | | 31.4 | |
| 3 | | | | | | 29.6 | | | 35.4 | |
| 4 | | | | | | 31.1 | | | 36.9 | |
| 5 | | | | | | 29.8 | | | 32.8 | |
| 6 | | | | | | 31.1 | | | 38.7 | |
| 7 | | | | | | 31.1 | | | 33.9 | |
| 8 | | | | | | 30.8 | | | 34.1 | |
| 9 | | | | | | 34.4 | | | 33.9 | |
| 10 | | | | | | 34.5 | | | 61.8 | |
| 11 | | | | 81.4 | | 36.1 | | 69.6 | 79.9 | |
| 12 | | | | 88.2 | | Cal | 68.5 | 72.2 | 79.0 | |
| 13 | | | | 81.7 | | Bad | 75.0 | 86.7 | 88.8 | |
| 14 | | | | 86.3 | | | 70.9 | 85.9 | 84.2 | |
| 15 | | | | 83.5 | | 60.1 | 71.5 | 83.2 | 85.5 | |
| 16 | 59.6 | | | 82.2 | | 58.4 | 74.2 | 81.0 | 83.1 | |
| 17 | 59.5 | | | 85.2 | Landings | 53.4 | 68.5 | 76.6 | 75.1 | Landings |
| 18 | 53.4 | | | 81.6 | | 53.5 | 75.3 | 81.0 | 82.2 | |
| 19 | 53.6 | | | 79.7 | | 41.7 | 69.9 | 71.7 | 67.6 | |
| 20 | 60.2 | | | 81.5 | | 27.8 | 26.5 | 33.1 | 36.5 | |
| 21 | 43.1 | | | 73.7 | | 28.1 | 25.5 | 35.8 | 35.5 | |
| 22 | 30.1 | | | 34.5 | | 38.3 | 40.5 | 45.3 | 48.3 | |
| 23 | 30.5 | | | 33.7 | | 38.5 | 41.3 | 43.9 | 44.0 | |
| 24 | 27.7 | | | 33.1 | | 38.2 | 41.8 | 44.2 | 43.8 | |
| DNL | | | | 80.2 | | | 67.7 | 77.7 | 79.1 | |
| CNEL | | | | 80.2 | | | 67.7 | 77.7 | 79.1 | |

TABLE A-1

HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Friday, Feb 16 | | | | | | Saturday, Feb 17 | | | | |
|----------------|--------|--------|--------|--------|-----------|------------------|--------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | 35.6 | 40.0 | 57.9 | 52.3 | Landings | | 23.3 | 34.4 | 35.0 | Landings |
| 2 | 33.1 | 28.0 | 36.9 | 32.5 | | | 23.1 | 35.6 | 35.1 | |
| 3 | 35.4 | 33.4 | 40.5 | 36.0 | | | 22.7 | 34.9 | 34.4 | |
| 4 | 35.5 | 33.9 | 41.7 | 36.8 | | | 23.1 | 35.0 | 33.2 | |
| 5 | 36.3 | 35.7 | 43.0 | 36.5 | | | 23.0 | 34.7 | 33.1 | |
| 6 | 37.3 | 38.5 | 45.9 | 39.3 | | | 24.1 | 38.5 | 36.4 | |
| 7 | 38.0 | 39.5 | 48.0 | 41.7 | | | 26.2 | 37.8 | 35.8 | |
| 8 | 38.1 | 53.0 | 64.9 | 65.5 | | | 26.7 | 38.1 | 35.3 | |
| 9 | 38.5 | 59.1 | 71.8 | 75.5 | | | 25.3 | 38.6 | 36.0 | |
| 10 | Bad | 62.9 | 75.6 | 81.6 | | | 44.4 | 50.3 | 38.2 | |
| 11 | Cal | 73.4 | 79.9 | 83.3 | | | 43.4 | 66.9 | 51.5 | |
| 12 | | 72.4 | 80.8 | 79.0 | | | 45.5 | 48.7 | 48.8 | |
| 13 | | 69.0 | 77.0 | 75.5 | | | 35.6 | 39.6 | 39.1 | |
| 14 | | 70.0 | 79.7 | 81.8 | | | 35.1 | 38.5 | 37.7 | |
| 15 | | 69.2 | 81.3 | 76.7 | | | 36.7 | 40.0 | 38.4 | |
| 16 | | 53.4 | 77.3 | 69.0 | | | 36.2 | 39.2 | 38.1 | |
| 17 | | 62.3 | 75.3 | 74.1 | | | 36.4 | 38.5 | 37.9 | |
| 18 | | 61.6 | 72.3 | 68.1 | | | 45.3 | 39.8 | 37.0 | |
| 19 | | 50.2 | 55.3 | 66.3 | | | 31.4 | 37.0 | 36.5 | |
| 20 | | 25.5 | 39.4 | 38.2 | | | 29.4 | 32.8 | 32.7 | |
| 21 | | 23.8 | 37.7 | 37.1 | | | 33.4 | 39.0 | 37.0 | |
| 22 | | 24.1 | 36.5 | 37.6 | | | 35.1 | 38.1 | 38.0 | |
| 23 | | 23.5 | 36.5 | 36.3 | | | 29.8 | 33.8 | 32.2 | |
| 24 | | 22.3 | 32.9 | 33.8 | | | 27.3 | 31.5 | 30.6 | |
| DNL | | 64.9 | 74.5 | 74.2 | | | 38.9 | 53.6 | 43.4 | |
| CNEL | | 64.9 | 74.5 | 74.2 | | | 39.1 | 53.7 | 43.4 | |

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Sunday, Feb 18 | | | | | | Monday, Feb 19 | | | | |
|----------------|--------|--------|--------|--------|-----------|----------------|--------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | 31.5 | 38.6 | | Landings | | 28.2 | 29.6 | 30.0 | Holiday |
| 2 | | 28.2 | 32.1 | | | | 28.1 | 31.4 | 31.2 | |
| 3 | | 35.8 | 39.1 | | | | 29.3 | 31.7 | 31.1 | |
| 4 | | 34.0 | 39.8 | 38.9 | | | 29.9 | 34.1 | 33.3 | |
| 5 | | 32.9 | 39.0 | 38.0 | | | 29.9 | 32.4 | 33.2 | |
| 6 | | 31.7 | 34.4 | 35.8 | | | 25.6 | 28.1 | 27.9 | |
| 7 | | 28.9 | 30.5 | 32.9 | | | 31.9 | 30.9 | 30.6 | |
| 8 | | 28.8 | 32.8 | 35.1 | | | 32.1 | 32.5 | 32.6 | |
| 9 | | 46.5 | 40.7 | 42.1 | | | 36.3 | 35.1 | 33.4 | |
| 10 | | 32.8 | 36.1 | 37.5 | | | 46.3 | 42.9 | 50.8 | |
| 11 | | 36.5 | 37.4 | 39.7 | | | 21.3 | 40.7 | 38.3 | |
| 12 | | 48.9 | 51.3 | 59.7 | | | 21.8 | 40.6 | 39.1 | |
| 13 | | 36.3 | 41.4 | 38.9 | | | 26.6 | 41.1 | 39.1 | |
| 14 | | 47.3 | 44.2 | 62.2 | | | 27.1 | 42.1 | 39.0 | |
| 15 | | 59.5 | 63.7 | 63.6 | | | 21.9 | 42.6 | 40.1 | |
| 16 | | 54.3 | 61.5 | 69.4 | | | 53.7 | 68.2 | 76.4 | |
| 17 | | 43.9 | 48.0 | 57.1 | | | 35.1 | 51.9 | 68.4 | |
| 18 | | 31.8 | 34.4 | 32.9 | | | 23.7 | 46.0 | 44.0 | |
| 19 | | 35.3 | 39.4 | 37.0 | | | 22.3 | 43.4 | 41.4 | |
| 20 | | 26.4 | 31.2 | 29.6 | | | 22.5 | 44.3 | 43.1 | |
| 21 | | 26.4 | 29.3 | 29.4 | | | 23.2 | 46.0 | 43.5 | |
| 22 | | 29.7 | 30.5 | 30.8 | | | 22.1 | 42.6 | 41.7 | |
| 23 | | 30.1 | 31.1 | 28.7 | | | 21.3 | 39.0 | 37.5 | |
| 24 | | 31.1 | 30.1 | 29.4 | | | 21.1 | 37.1 | 36.3 | |
| DNL | | 47.9 | 52.7 | 57.7 | | | 41.9 | 54.9 | 63.3 | |
| CNEL | | 47.9 | 52.7 | 57.7 | | | 41.9 | 55.0 | 63.3 | |

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Tuesday, Feb 20 | | | | | | Wednesday, Feb 21 | | | | |
|-----------------|--------|--------|--------|--------|-----------|-------------------|--------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | 22.0 | 41.3 | 38.6 | Takeoffs | | 25.7 | 34.2 | 30.7 | Takeoffs |
| 2 | | 21.0 | 34.4 | 36.4 | | | 33.9 | 48.5 | 38.1 | |
| 3 | | 21.1 | 34.1 | 33.7 | | | 27.5 | 35.8 | 32.0 | |
| 4 | | 21.0 | 32.0 | 31.6 | | | 27.9 | 34.6 | 32.8 | |
| 5 | | 21.0 | 31.8 | 32.0 | | | 25.6 | 29.4 | 31.3 | |
| 6 | | 21.0 | 32.0 | 32.3 | | | 26.1 | 30.4 | 29.5 | |
| 7 | | 21.0 | 32.3 | 32.5 | | | 69.4 | 77.1 | 76.7 | |
| 8 | | 21.0 | 30.5 | 31.4 | | | 72.6 | 80.2 | 79.8 | |
| 9 | | 23.6 | 29.3 | 30.3 | | | 79.3 | 86.2 | 86.4 | |
| 10 | | 62.5 | 64.8 | 75.3 | | | 75.9 | 81.5 | 84.0 | |
| 11 | | 57.4 | 58.3 | 66.7 | | | 72.4 | 72.1 | 77.8 | |
| 12 | | 74.4 | 75.5 | 85.4 | | | 68.3 | 72.3 | 76.1 | |
| 13 | | 74.8 | 77.0 | 81.1 | Landings | | 75.6 | 76.3 | 82.5 | Takeoffs |
| 14 | | 66.1 | 66.8 | 76.4 | | | 70.5 | 72.5 | 73.5 | |
| 15 | | 77.1 | 76.4 | 76.8 | | | 66.5 | 66.1 | 75.6 | |
| 16 | | 76.0 | 77.5 | 81.1 | | | 33.5 | 41.8 | 35.7 | |
| 17 | | 74.2 | 81.1 | 81.8 | | | 38.7 | 43.0 | 42.2 | |
| 18 | | 78.2 | 78.5 | 83.1 | | | 59.6 | 59.9 | 74.2 | |
| 19 | | 76.0 | 80.5 | 83.0 | | | 25.5 | 28.7 | 33.4 | |
| 20 | | 34.1 | 34.3 | 36.9 | | | 24.8 | 27.8 | 30.3 | |
| 21 | | 33.2 | 33.8 | 35.1 | | | 25.0 | 28.0 | 30.9 | |
| 22 | | 38.1 | 38.7 | 39.1 | | | 26.6 | 29.8 | 31.4 | |
| 23 | | 32.2 | 41.3 | 38.0 | | | 23.7 | 26.8 | 29.3 | |
| 24 | | 27.5 | 33.4 | 32.3 | | | 24.8 | 27.2 | 29.9 | |
| ENL | | 70.8 | 73.3 | 77.4 | | | 71.1 | 77.2 | 78.3 | |
| CNEL | | 70.8 | 73.3 | 77.4 | | | 71.1 | 77.2 | 78.3 | |

TABLE A-1

HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Thursday, Feb 22 | | | | | | Friday, Feb 23 | | | | |
|------------------|--------|--------|--------|--------|-----------|----------------|--------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | 24.1 | 27.9 | 30.1 | Takeoffs | | 31.6 | 33.8 | 33.8 | Landings |
| 2 | | 24.0 | 27.0 | 29.6 | | | 25.0 | 28.6 | 30.6 | |
| 3 | | 23.9 | 26.9 | 29.5 | | | 25.5 | 29.8 | 31.0 | |
| 4 | | 24.1 | 26.9 | 30.0 | | | 27.0 | 35.8 | 31.9 | |
| 5 | | 24.1 | 27.2 | 30.3 | | | 26.5 | 35.0 | 32.1 | |
| 6 | | 25.8 | 27.1 | 30.6 | | | 26.5 | 32.5 | 30.5 | |
| 7 | | 27.2 | 27.6 | 31.1 | | | 27.8 | 29.1 | 29.1 | |
| 8 | | 27.6 | 29.6 | 32.6 | | | 45.3 | 73.4 | 50.2 | |
| 9 | | 33.0 | 29.7 | 32.0 | | | | 82.4 | 77.3 | |
| 10 | | 33.4 | 32.9 | 34.1 | | | | 80.1 | 82.1 | |
| 11 | | 62.6 | 62.0 | 74.8 | | | Bad | 77.5 | 82.6 | |
| 12 | | 73.1 | 71.9 | 80.0 | | | | 81.5 | 84.9 | |
| 13 | | 76.5 | 75.6 | 84.1 | | | | 82.4 | 77.4 | |
| 14 | | 59.9 | 63.3 | 69.2 | | | | 82.0 | 81.4 | |
| 15 | | 141.2* | 79.4 | 84.3 | | | | 80.3 | 81.0 | |
| 16 | | 81.6 | 85.2 | 84.5 | | | | 77.7 | 82.4 | |
| 17 | | | 85.6 | 84.7 | | | | 76.4 | 74.6 | |
| 18 | | | 83.7 | 83.0 | | | | 75.5 | 79.7 | |
| 19 | | 73.3 | 80.1 | 78.9 | | | | 80.0 | 73.3 | |
| 20 | | 62.9 | 69.5 | 66.2 | | | | 29.3 | 30.5 | |
| 21 | | 49.3 | 55.1 | 58.4 | | | | 37.8 | 36.8 | |
| 22 | | 28.6 | 31.6 | 31.9 | | | | 30.6 | 29.7 | |
| 23 | | 25.7 | 27.6 | 29.1 | | | | 33.3 | 33.5 | |
| 24 | | 32.1 | 34.1 | 34.8 | | | | 29.5 | 30.1 | |
| DNL | | | 77.0 | 78.0 | | | | 76.9 | 77.5 | |
| CNEL | | | 77.0 | 78.1 | | | | 76.9 | 77.5 | |

*Equipment malfunction

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Saturday, Feb 24 | | | | | | Sunday, Feb 25 | | | | |
|------------------|--------|--------|--------------|--------------|-----------|----------------|--------|--------------|--------------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 2 | | | 30.1 34.0 | | Landings | | | 34.1 32.5 | 36.2 31.1 | Landings |
| 3 4 | | | 33.1 29.5 | 33.0 30.7 | | | | 35.9 30.5 | 38.6 31.9 | |
| 5 6 | | | 34.3 31.0 | 31.8 31.1 | | | | 40.2 38.1 | 40.0 36.9 | |
| 7 8 | | | 39.9 46.3 | 38.7 40.8 | | | | 33.9 40.9 | 30.0 38.7 | |
| 9 10 | | | 52.4 53.5 | 45.7 47.0 | | | | 44.0 44.3 | 39.1 38.9 | |
| 11 12 | | | 52.0 60.7 | 54.7 54.9 | | | | 45.0 72.9 | 35.9 57.7 | |
| 13 14 | | | 69.9 64.7 | 63.5 51.1 | | | | 67.7 69.8 | 77.2 71.3 | |
| 15 16 | | | 72.5 67.9 | 55.0 60.0 | | | | 66.8 73.0 | 75.3 79.1 | |
| 17 18 | | | 80.9 65.3 | 83.3 76.9 | | | | 55.8 64.1 | 54.9 57.2 | |
| 19 20 | | | 49.1 35.5 | 40.4 32.0 | | | | 34.7 34.7 | 35.2 35.4 | |
| 21 22 | | | 41.2 40.9 | 39.4 39.3 | | | | 30.8 27.7 | 30.0 31.5 | |
| 23 24 | | | 28.6 28.7 | | | | | 27.5 36.1 | 30.6 36.0 | |
| DNL | | | 68.4 | 70.5 | | | | 64.2 | 68.9 | |
| CNEL | | | 68.4 | 70.5 | | | | 64.2 | 68.9 | |

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Hour | Monday, Feb 26 | | | | | Tuesday, Feb 27 | | | | |
|------|----------------|--------|--------|--------|-----------|-----------------|--------|--------|--------|-----------|
| | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | | 32.1 | | Takeoffs | | | 41.4 | 40.1 | Takeoffs |
| 2 | | | 31.1 | | | | | 37.5 | 35.4 | |
| 3 | | | 30.1 | 31.6 | | | | 37.8 | 35.7 | |
| 4 | | | 29.7 | 30.8 | | | | 38.6 | 36.5 | |
| 5 | | | 27.8 | 28.7 | | | | 32.1 | 31.5 | |
| 6 | | | 30.4 | 29.9 | | | | 30.4 | 27.3 | |
| 7 | | | 31.5 | 32.4 | | | | 63.6 | 66.8 | |
| 8 | | | 74.5 | 80.6 | | | | 76.7 | 82.1 | |
| 9 | | | 79.3 | 82.2 | | | | 83.8 | 82.1 | |
| 10 | | | 79.5 | 81.8 | | | | 81.1 | 85.5 | |
| 11 | | | 79.7 | 82.0 | | | | 85.1 | 85.2 | |
| 12 | | | 83.6 | 84.6 | | | | 84.2 | 84.5 | |
| 13 | | | 82.4 | 79.5 | | | | 84.2 | 83.1 | |
| 14 | | | 82.3 | 83.9 | | | | 85.2 | 84.4 | |
| 15 | | | 82.3 | 82.8 | | | | 85.4 | 85.1 | |
| 16 | | | 84.2 | 83.1 | | | | 82.7 | 84.6 | |
| 17 | | | 82.9 | 81.9 | | | | 83.5 | 84.5 | |
| 18 | | | 79.0 | 77.0 | | | | 85.2 | 85.1 | |
| 19 | | | 76.7 | 68.0 | | | | 83.1 | 78.1 | |
| 20 | | | 59.0 | 61.6 | | | | 55.7 | 38.2 | |
| 21 | | | 57.4 | 59.0 | | | | 39.5 | 38.6 | |
| 22 | | | 32.4 | 33.1 | | | | 36.1 | 33.8 | |
| 23 | | | 33.8 | 34.0 | | | | 53.6 | 45.9 | |
| 24 | | | 34.8 | 33.3 | | | | 29.3 | 30.6 | |
| DNL | | | 78.4 | 78.7 | | | | 80.9 | 81.1 | |
| CNEL | | | 78.4 | 78.7 | | | | 80.9 | 81.1 | |

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Hour | Wednesday, Feb 28 | | | | | Thursday, Mar 1 | | | | |
|------|-------------------|--------|--------|--------|-----------|-----------------|--------|--------|--------|-----------|
| | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | | 31.0 | 31.9 | Landings | | | 28.8 | 21.6 | Takeoffs |
| 2 | | | 35.4 | 34.0 | | | | 27.9 | 24.1 | |
| 3 | | | 30.2 | 30.1 | | | | 32.5 | 32.1 | |
| 4 | | | 37.1 | 31.8 | | | | 32.2 | 30.8 | |
| 5 | | | 39.1 | 39.9 | | | | 29.3 | 28.8 | |
| 6 | | | 37.6 | 34.9 | | | | 32.7 | 31.8 | |
| 7 | | | 68.4 | 47.2 | | | | 62.3 | 70.0 | |
| 8 | | | 80.3 | 68.3 | | | | 59.9 | 66.5 | |
| 9 | | | 75.5 | 76.0 | | | | 74.9 | 75.3 | |
| 10 | | | 81.1 | 74.4 | | | | 76.0 | 82.3 | |
| 11 | | | 72.6 | 76.1 | | | | 67.1 | 72.2 | |
| 12 | | | 80.7 | 87.6 | | | | 66.3 | 75.6 | |
| 13 | | | 78.9 | 79.3 | | | | 81.0 | 78.2 | |
| 14 | | | 78.5 | 81.1 | | | | 78.4 | 81.8 | |
| 15 | | | 82.2 | 81.0 | | | | 80.7 | 84.0 | |
| 16 | | | 76.8 | 80.0 | | | | 82.7 | 83.3 | |
| 17 | | | 76.9 | 80.2 | | | | 82.4 | 83.3 | |
| 18 | | | 74.8 | 78.3 | | | | 83.0 | 83.7 | |
| 19 | | | 70.0 | 74.4 | | | | 80.9 | 75.7 | |
| 20 | | | 75.4 | 66.6 | | | | 83.4 | 74.7 | |
| 21 | | | 78.2 | 67.1 | | | | 82.3 | 74.4 | |
| 22 | | | 71.3 | 61.9 | | | | 78.7 | 70.7 | |
| 23 | | | 35.1 | 31.3 | | | | 50.1 | 49.9 | |
| 24 | | | 36.1 | 34.2 | | | | 47.3 | 47.2 | |
| DNL | | | 76.4 | 75.5 | | | | 78.1 | 78.3 | |
| CNEL | | | 77.2 | 77.6 | | | | 80.2 | 78.6 | |

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Hour | Friday, Mar 2 | | | | | Saturday, Mar 3 | | | | |
|------|---------------|--------|--------|--------|-----------|-----------------|--------|--------|--------|-----------|
| | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | | 48.8 | 46.5 | Takeoffs | | | 39.7 | 39.8 | Takeoffs |
| 2 | | | 47.0 | 45.3 | | | | 41.0 | 39.9 | |
| 3 | | | 45.4 | 43.3 | | | | 33.6 | 35.3 | |
| 4 | | | 46.7 | 46.1 | | | | 39.0 | 38.0 | |
| 5 | | | 46.5 | 45.4 | | | | 34.3 | 34.8 | |
| 6 | | | 41.0 | 39.3 | | | | 37.9 | 37.8 | |
| 7 | | | 38.7 | 39.6 | | | | 38.1 | 37.2 | |
| 8 | | | 41.8 | 44.5 | | | | 37.1 | 35.3 | |
| 9 | | | 67.1 | 63.3 | | | | 40.9 | 40.0 | |
| 10 | | | 74.7 | 80.6 | | | | 53.2 | 52.4 | |
| 11 | | | 70.7 | 80.5 | | | | 58.3 | 55.8 | |
| 12 | | | 53.4 | 55.4 | | | | 67.0 | 50.4 | |
| 13 | | | 67.4 | 76.6 | | | | 62.1 | 64.9 | |
| 14 | | | 82.1 | 85.2 | | | | 69.4 | 57.1 | |
| 15 | | | 83.2 | 82.1 | | | | 68.4 | 73.6 | |
| 16 | | | 79.4 | 82.8 | | | | 59.6 | 48.7 | |
| 17 | | | 84.0 | 79.1 | | | | 75.1 | 77.0 | |
| 18 | | | 63.4 | 74.4 | | | | 52.7 | 41.7 | |
| 19 | | | 50.8 | 50.9 | | | | 53.6 | 51.7 | |
| 20 | | | 59.2 | 53.7 | | | | 55.7 | 51.7 | |
| 21 | | | 46.1 | 43.4 | | | | 41.7 | 39.7 | |
| 22 | | | 47.3 | 43.1 | | | | 35.6 | 36.4 | |
| 23 | | | 47.9 | 43.6 | | | | 37.3 | 34.7 | |
| 24 | | | 41.5 | 37.7 | | | | 36.4 | 36.0 | |
| DNL | | | 75.1 | 76.5 | | | | 63.9 | 65.1 | |
| CNEL | | | 75.1 | 76.5 | | | | 64.0 | 65.1 | |

TABLE A-1
HOURLY NOISE LEVELS (dB) AT LAUGHLIN AFB

| Sunday, Mar 4 | | | | | | Monday, Mar 5 | | | | |
|---------------|--------|--------|--------|--------|-----------|---------------|--------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Site 4 | Operation | Site 1 | Site 2 | Site 3 | Site 4 | Operation |
| 1 | | | 32.0 | 33.0 | Takeoffs | | | 29.9 | 29.1 | Takeoffs |
| 2 | | | 30.5 | 30.1 | | | | 30.1 | 29.7 | |
| 3 | | | 30.1 | 30.5 | | | | 30.2 | 29.3 | |
| 4 | | | 29.2 | 29.2 | | | | 30.5 | 29.4 | |
| 5 | | | 30.8 | 29.6 | | | | 30.6 | 29.4 | |
| 6 | | | 31.1 | 34.4 | | | | 30.9 | 29.4 | |
| 7 | | | 36.4 | 36.0 | | | | 59.4 | 69.3 | |
| 8 | | | 36.1 | 37.4 | | | | 75.8 | 81.7 | |
| 9 | | | 33.7 | 41.0 | | | | 83.4 | 83.5 | |
| 10 | | | 36.3 | 36.3 | | | | 81.8 | 83.3 | |
| 11 | | | 37.9 | 35.0 | | | | 83.0 | 82.6 | |
| 12 | | | 60.7 | 53.8 | | | | 82.5 | 83.0 | |
| 13 | | | 48.2 | 69.4 | | | | 83.3 | 82.5 | |
| 14 | | | 74.7 | 79.5 | | | | 83.0 | 85.7 | |
| 15 | | | 74.6 | 71.5 | | | | | | |
| 16 | | | 68.4 | 65.7 | | | | | | |
| 17 | | | 60.2 | 58.6 | | | | | | |
| 18 | | | 42.9 | 42.5 | | | | | | |
| 19 | | | 45.1 | 46.5 | | | | | | |
| 20 | | | 38.1 | 35.7 | | | | | | |
| 21 | | | 27.0 | 28.4 | | | | | | |
| 22 | | | 30.5 | 28.7 | | | | | | |
| 23 | | | 28.7 | 30.1 | | | | | | |
| 24 | | | 29.2 | 29.8 | | | | | | |
| DNL | | | 64.5 | 67.0 | | | | 77.0 | 78.3 | |
| CNEL | | | 64.5 | 67.0 | | | | | | |

TABLE A-2

WEATHER AT LAUGHLIN AFB

| | Feb 14 | Feb 15 | Feb 16 | Feb 17 | Feb 18 | Feb 19 | Feb 20 |
|--------------|---------|---------|---------|--------|--------|---------|---------|
| Hour | °F % | °F % | °F % | °F % | °F % | °F % | °F % |
| 1 | 57 74 | 60 77 | 47 63 | 32 63 | 33 75 | 37 78 | 42 79 |
| 2 | 55 77 | 60 77 | 47 60 | 32 63 | 32 78 | 35 84 | 42 82 |
| 3 | 55 77 | 59 86 | 46 60 | 32 61 | 31 81 | 33 89 | 41 93 |
| 4 | 53 79 | 59 89 | 44 62 | 31 63 | 30 84 | 32 88 | 41 96 |
| 5 | 52 86 | 56 96 | 43 65 | 31 66 | 31 81 | 32 92 | 41 96 |
| 6 | 53 93 | 55 96 | 40 75 | 30 68 | 31 78 | 31 92 | 41 100 |
| 7 | 52 96 | 54 96 | 38 78 | 29 71 | 30 81 | 31 92 | 41 100 |
| 8 | 53 96 | 57 96 | 37 72 | 29 71 | 31 78 | 32 92 | 41 100 |
| 9 | 55 100 | 58 100 | 37 64 | 29 74 | 34 72 | 33 92 | 43 96 |
| 10 | 57 93 | 60 100 | 36 61 | 30 74 | 38 61 | 35 88 | 44 96 |
| 11 | 61 83 | 64 84 | 36 58 | 31 68 | 43 55 | 37 81 | 44 96 |
| 12 | 64 75 | 65 81 | 36 56 | 33 63 | 45 53 | 38 78 | 45 93 |
| 13 | 70 61 | 72 63 | 36 54 | 34 63 | 49 48 | 40 73 | 47 86 |
| 14 | 73 55 | 73 59 | 36 54 | 37 58 | 50 46 | 44 65 | 48 86 |
| 15 | 76 48 | 80 41 | 35 53 | 39 54 | 52 46 | 45 65 | 52 73 |
| 16 | 80 39 | 84 27 | 35 53 | 39 54 | 54 44 | 44 65 | 55 68 |
| 17 | 80 39 | 83 27 | 35 53 | 41 50 | 54 44 | 45 60 | 56 66 |
| 18 | 78 42 | 81 28 | 35 56 | 41 52 | 54 46 | 43 65 | 55 68 |
| 19 | 70 54 | 75 35 | 34 58 | 40 54 | 49 54 | 42 67 | 54 68 |
| 20 | 70 54 | 68 47 | 34 58 | 38 61 | 43 62 | 41 70 | 51 76 |
| 21 | 65 65 | 59 61 | 34 58 | 37 66 | 41 67 | 41 73 | 49 79 |
| 22 | 64 67 | 60 49 | 33 61 | 36 69 | 39 72 | 39 78 | 47 82 |
| 23 | 62 72 | 54 54 | 33 61 | 35 72 | 39 72 | 39 78 | 44 89 |
| 24 | 62 72 | 49 58 | 33 63 | 34 75 | 38 75 | 41 79 | 41 93 |
| Ave | 63° 71% | 64° 68% | 38° 61% | NA | NA | Holiday | 46° 86% |
| Ave (Cps) | 70° 59% | 74° 55% | 36° 58% | NA | NA | NA | 50° 80% |

TABLE A-2

WEATHER AT LAUGHLIN AFB

| | Feb 21 | | Feb 22 | | Feb 23 | | Feb 24 | | Feb 25 | | Feb 26 | | Feb 27 | |
|--------------|--------|-----|--------|-----|--------|-----|--------|----|--------|----|--------|-----|--------|-----|
| Hour | °F | % | °F | % | °F | % | °F | % | °F | % | °F | % | °F | % |
| 1 | 40 | 96 | 56 | 100 | 52 | 100 | 57 | 89 | 46 | 65 | 41 | 59 | 52 | 54 |
| 2 | 39 | 96 | 55 | 100 | 53 | 100 | 56 | 93 | 44 | 67 | 38 | 67 | 51 | 56 |
| 3 | 38 | 96 | 55 | 100 | 55 | 96 | 57 | 93 | 43 | 70 | 37 | 66 | 51 | 66 |
| 4 | 39 | 96 | 55 | 100 | 58 | 93 | 59 | 96 | 42 | 73 | 36 | 69 | 50 | 68 |
| 5 | 39 | 96 | 55 | 100 | 57 | 96 | 59 | 96 | 43 | 70 | 33 | 75 | 47 | 76 |
| 6 | 39 | 96 | 55 | 100 | 56 | 96 | 56 | 86 | 41 | 73 | 33 | 75 | 46 | 76 |
| 7 | 38 | 96 | 55 | 100 | 56 | 96 | 50 | 73 | 40 | 72 | 32 | 75 | 46 | 79 |
| 8 | 39 | 93 | 55 | 100 | 54 | 96 | 52 | 71 | 42 | 73 | 39 | 61 | 47 | 79 |
| 9 | 44 | 96 | 56 | 100 | 59 | 89 | 55 | 63 | 45 | 55 | 46 | 51 | 51 | 76 |
| 10 | 48 | 92 | 58 | 96 | 64 | 62 | 56 | 56 | 48 | 45 | 50 | 44 | 56 | 68 |
| 11 | 52 | 85 | 69 | 96 | 67 | 50 | 60 | 45 | 50 | 40 | 53 | 41 | 60 | 59 |
| 12 | 56 | 83 | 62 | 93 | 73 | 32 | 62 | 39 | 53 | 36 | 57 | 35 | 62 | 57 |
| 13 | 55 | 89 | 66 | 78 | 77 | 27 | 68 | 24 | 57 | 33 | 60 | 33 | 65 | 51 |
| 14 | 55 | 93 | 68 | 73 | 78 | 27 | 69 | 22 | 59 | 30 | 63 | 28 | 70 | 43 |
| 15 | 55 | 96 | 70 | 68 | 79 | 26 | 71 | 20 | 61 | 28 | 65 | 28 | 70 | 45 |
| 16 | 56 | 96 | 71 | 66 | 78 | 26 | 70 | 21 | 62 | 27 | 64 | 28 | 72 | 44 |
| 17 | 56 | 96 | 72 | 61 | 79 | 25 | 69 | 20 | 62 | 25 | 64 | 28 | 72 | 42 |
| 18 | 56 | 100 | 72 | 63 | 77 | 26 | 68 | 19 | 61 | 25 | 63 | 28 | 72 | 42 |
| 19 | 56 | 100 | 65 | 78 | 72 | 32 | 63 | 20 | 57 | 30 | 60 | 32 | 66 | 48 |
| 20 | 56 | 100 | 59 | 89 | 66 | 41 | 57 | 29 | 53 | 36 | 57 | 37 | 62 | 57 |
| 21 | 55 | 100 | 58 | 89 | 62 | 47 | 57 | 49 | 47 | 48 | 54 | 43 | 59 | 64 |
| 22 | 55 | 100 | 58 | 89 | 62 | 49 | 53 | 56 | 42 | 60 | 54 | 43 | 58 | 64 |
| 23 | 55 | 100 | 57 | 96 | 57 | 68 | 51 | 56 | 40 | 67 | 54 | 43 | 52 | 76 |
| 24 | 55 | 100 | 56 | 96 | 58 | 80 | 49 | 58 | 39 | 67 | 54 | 43 | 52 | 79 |
| Ave | 49° | 95% | 60° | 80% | 65° | 62% | NA | | NA | | 50° | 47% | 58° | 61% |
| Ave (Ops) | 50° | 92% | 67° | 77% | 73° | 38% | NA | | NA | | 57° | 36% | 62° | 56% |

TABLE A-2

WEATHER AT LAUGHLIN AFB

| | Feb 28 | Mar 1 | Mar 2 | Mar 3 | Mar 4 | Mar 5 | |
|--------------|---------|---------|---------|-------|---------|-------|------|
| Hour | °F % | °F % | °F % | °F % | °F % | °F % | °F % |
| 1 | 54 73 | 46 62 | 62 80 | | | | |
| 2 | 53 73 | 45 65 | 61 83 | | | | |
| 3 | 50 89 | 49 54 | 60 89 | | | | |
| 4 | 49 93 | 49 56 | 60 93 | | | | |
| 5 | 44 96 | 51 54 | 60 93 | | | | |
| 6 | 45 68 | 53 58 | 60 93 | | | | |
| 7 | 42 73 | 51 68 | 60 100 | | | | |
| 8 | 46 63 | 54 71 | 61 96 | | | | |
| 9 | 56 45 | 56 80 | 62 100 | | | | |
| 10 | 62 38 | 58 80 | 65 93 | | | | |
| 11 | 63 38 | 58 83 | 62 90 | | | | |
| 12 | 65 34 | 59 83 | 71 78 | | | | |
| 13 | 67 32 | 64 70 | 73 71 | | | | |
| 14 | 69 31 | 67 63 | 76 64 | | | | |
| 15 | 71 27 | 68 61 | 76 62 | | | | |
| 16 | 71 25 | 68 61 | 79 56 | | | | |
| 17 | 72 23 | 68 63 | 77 57 | | | | |
| 18 | 71 23 | 67 65 | 78 55 | | | | |
| 19 | 67 24 | 65 72 | 71 75 | | | | |
| 20 | 66 28 | 64 75 | 59 71 | | | | |
| 21 | 62 33 | 64 75 | 60 66 | | | | |
| 22 | 51 54 | 65 70 | 59 59 | | | | |
| 23 | 50 54 | 64 72 | 57 54 | | Busy | Total | |
| 24 | 48 58 | 63 77 | 54 56 | | Day | Day | |
| Ave | 58° 50% | 59° 68% | 65° 76% | | 56° 70% | | |
| Ave (Ops) | 64° 35% | 62° 71% | 72° 73% | | 61° 60% | | |

TABLE A-3

RSU OBSERVER FLIGHT TRACK UTILIZATION COUNTS
AT LAUGHLIN AFB TX

| <u>T-38</u> <u>Operations</u> | <u>Straight-Out</u> <u>Departure</u> | <u>Crosswind</u> <u>Pattern</u> | <u>Closed</u> <u>Pattern</u> |
|----------------------------------|---|------------------------------------|---------------------------------|
| Left Runway | | | |
| Operations Observed | 4 | 32 | 225 |
| % Utilization | 2% | 12% | 86% |
| Center Runway | | | |
| Operations Observed | 79 | 11 | 4 |
| % Utilization | 84% | 12% | 4% |

| <u>T-37</u> <u>Operations</u> | <u>Straight-Out</u> <u>Departure</u> | <u>Depart</u> <u>10°</u> | <u>Crosswind</u> <u>Pattern</u> | <u>Closed</u> <u>Pattern</u> |
|----------------------------------|---|-----------------------------|------------------------------------|---------------------------------|
| Right Runway | | | | |
| Operation Observed | 4 | 15 | 17 | 34 |
| % Utilization | 6% | 21% | 24% | 49% |

TABLE A-4
TOTAL BASE TRAFFIC COUNT
AT LAUGHLIN AFB TX

Operations Over NOISECHECK Units = Count/2 *

| Date | Operation | Tower Count | Lariat Count | Honcho Count | # T-38s Flying | # T-37s Flying |
|--------|-----------|----------------|-----------------|-----------------|-------------------|-------------------|
| Feb 14 | Takeoffs | 278 | 620 | 430 | 122 | 99 |
| Feb 15 | Takeoffs | 62 | 426 | 392 | 55 | 72 |
| Feb 15 | Landings | 162 | 310 | 202 | 40 | 37 |
| Feb 16 | Landings | 364 | 500 | 770 | 66 | 82 |
| Feb 17 | Saturday | 4 | | | | |
| Feb 18 | Sunday | 16 | | | | |
| Feb 19 | Holiday | 0 | | | | |
| Feb 20 | Takeoff | 240 | 98 | 108 | 27 | 19 |
| Feb 20 | Landings | 24 | 190 | 240 | 53 | 43 |
| Feb 21 | Takeoffs | 234 | 232 | 300 est | 69 | 40 |
| Feb 22 | Takeoffs | 244 | 1420 | 260 | 150 est | 57 |
| Feb 23 | Landings | 282 | 892 | 678 | 150 | 135 |
| Feb 24 | Saturday | 24 | | | | |
| Feb 25 | Sunday | 92 | | | | |
| Feb 26 | Takeoffs | 426 | 1000 | 710 | 132 | 158 |
| Feb 27 | Takeoffs | 508 | 938 | 752 | 150 | 169 |
| Feb 28 | Landings | 312 | 1020 | 1006 | 151 | 179 |
| Mar 1 | Takeoffs | 692 | 615 | 316 | 104 | 93 |
| Mar 2 | Takeoffs | 204 | 272 | 166 | 56 | 21 |

* 1 Takeoff and 1 Landing = Count of 2

TABLE A-5

T-38 DAILY OPERATIONS
AT LAUGHLIN APB TX

| Date | Operation | Center Runway | | | Left Runway | | |
|--------|-----------|---------------|-----------|--------|-------------|-----------|--------|
| | | St Out | Crosswind | Closed | St Out | Crosswind | Closed |
| Feb 14 | Takeoff | 117 | 17 | 5 | 6 | 37 | 267 |
| Feb 15 | Takeoff | 26 | 4 | 1 | 4 | 26 | 183 |
| Feb 15 | Landing | 81 | | | 3 | | 152 |
| Feb 16 | Landing | 182 | | 5 | | | 245 |
| Feb 17 | Saturday | | | | | | |
| Feb 18 | Sunday | | | | | | |
| Feb 19 | Holiday | | | | | | |
| Feb 20 | Takeoff | 101 | 14 | 5 | 1 | 6 | 42 |
| Feb 20 | Landing | 12 | | | 2 | | 93 |
| Feb 21 | Takeoff | 98 | 14 | 5 | 3 | 16 | 113 |
| Feb 22 | Takeoff | 102 | 15 | 5 | 14 | 85 | 611 |
| Feb 23 | Landing | 141 | | | 9 | | 437 |
| Feb 24 | Saturday | | | | | | |
| Feb 25 | Sunday | | | | | | |
| Feb 26 | Takeoff | 179 | 26 | 9 | 10 | 60 | 430 |
| Feb 27 | Takeoff | 213 | 30 | 10 | 9 | 56 | 403 |
| Feb 28 | Landing | 156 | | | 10 | | 500 |
| Mar 1 | Takeoff | 291 | 42 | 14 | 6 | 37 | 264 |
| Mar 2 | Takeoff | 86 | 12 | 4 | 3 | 16 | 117 |

Average
Busy Day

12 Busy Days During Field Test

| | | | | | | |
|----------|-------|------|-----|-----|------|-------|
| Takeoffs | 101.0 | 14.5 | 4.8 | 4.7 | 28.2 | 202.5 |
| Landings | 47.7 | 0 | 0 | 2.5 | 0 | 118.9 |

TABLE A-6
T-37 DAILY OPERATIONS
AT LAUGHLIN AFB TX

| Date | Operation | Depart | Depart 10° | Crosswind | Closed |
|--------|-----------|--------|------------|-----------|--------|
| Feb 14 | Takeoffs | 13 | 45 | 52 | 105 |
| Feb 15 | Takeoffs | 12 | 41 | 47 | 96 |
| Feb 15 | Landings | 27 | | | 64 |
| Feb 16 | Landings | 104 | | | 281 |
| Feb 17 | Saturday | | | | |
| Feb 18 | Sunday | | | | |
| Feb 19 | Holiday | | | | |
| Feb 20 | Takeoffs | 3 | 11 | 13 | 26 |
| Feb 20 | Landings | 32 | | | 76 |
| Feb 21 | Takeoffs | 9 | 32 | 36 | 74 |
| Feb 22 | Takeoffs | 8 | 27 | 31 | 64 |
| Feb 23 | Landings | 91 | | | 247 |
| Feb 24 | Saturday | | | | |
| Feb 25 | Sunday | | | | |
| Feb 26 | Takeoff | 21 | 75 | 85 | 174 |
| Feb 27 | Takeoff | 22 | 79 | 90 | 184 |
| Feb 28 | Landing | 136 | | | 367 |
| Mar 1 | Takeoffs | 10 | 33 | 38 | 77 |
| Mar 2 | Takeoffs | 5 | 17 | 20 | 41 |

Average
Busy Day

12 Busy Days During Field Test

| | | | | |
|----------|------|------|------|------|
| Takeoffs | 8.6 | 30.0 | 34.3 | 70.1 |
| Landings | 32.6 | 0 | 0 | 86.2 |

TABLE A-7

PILOT SUMMARY OF OPERATING PARAMETERS AT POINT
OF CLOSEST APPROACH TO MICROPHONE LOCATIONS
AT LAUGHLIN AFB TX

| | Site 2 Takeoff | Site 3 Takeoff | Site 4 Takeoff |
|------------------|----------------------------------|----------------------------------|----------------------------------|
| T-38 | 15,600 ft. from brake release | 10,800 ft. from brake release | 12,600 ft. from brake release |
| Power setting | Mil power | A/B or Mil | Mil power |
| Airspeed | 290 kts | 230 kts | 200 kts |
| Altitude | 600 ft | 400 ft | 500 ft |
| T-37 | | | |
| Power setting | Mil power | Mil power | Mil power |
| Airspeed | 180 kts | 140 kts | 160 kts |
| Altitude | 1000 ft | 300 ft | 500 ft |

TABLE A-8

SUMMARY OF ALTITUDE VERIFICATION FROM PHOTOS

| | T-38 Depart Center | T-38 Cross- wind Left | T-37 Depart | T-37 Cross- wind | T-37 Closed |
|---------------------------|--------------------------|--------------------------------|--------------------------------|------------------------|----------------|
| <hr/> | | | | | |
| Site 4 | | | | | |
| #Photos | 1 | 2 | 1 | 1 | 2 |
| Average Slant Distance | 638 ft | 1965 ft | 1007 ft | 2198 ft | 3472 ft |
| | T-38 Landing Left | | | | |
| <hr/> | | | | | |
| Site 3 | | | | | |
| # Photos | 3 | | | | |
| Average Slant Distance | 414 ft | | | | |
| | T-38 Depart Center | T-38 Depart Left | T-38 Cross- wind Left | T-38 Closed Left | T-38 Depart |
| <hr/> | | | | | |
| Site 2 | | | | | |
| # Photos | 3 | 2 | 5 | 13 | 4 |
| Average Slant Distance | 1812 ft | 702 ft | 2025 ft | 3620 ft | 2323 ft |

APPENDIX B

HOMESTEAD AFB DATA

TABLE B-1
HOURLY NOISE LEVELS (dB) AT HOMESTEAD AFB

| September 11 | | | | | September 12 | | | |
|--------------|--------|--------|--------|-----------|---------------------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Operation | Site 1 | Site 2 | Site 3 | Operation |
| 1 | | | | Landings | | | 45.0 | Landings |
| 2 | | | | | | | 45.8 | |
| 3 | | | | | | | 47.1 | |
| 4 | 44.2 | | | | | | 46.2 | |
| 5 | 43.7 | | | | | | 44.6 | |
| 6 | 42.5 | | | | | | 43.4 | |
| 7 | 44.7 | | | | | | 50.0 | Takeoffs |
| 8 | 57.4 | | | | | | 50.0 | |
| 9 | 65.3 | | | | | | 44.4 | |
| 10 | 70.5 | 49.0 | | | 80.5 | 67.3 | 69.2 | |
| 11 | 81.6 | 72.7 | | | 79.8 | 67.9 | 72.2 | |
| 12 | 76.8 | 69.5 | | | 82.5 | 72.1 | 71.4 | |
| 13 | 75.4 | 70.9 | | | 61.4 | | 59.4 | Landings |
| 14 | 75.4 | 67.5 | | | 81.5 | 74.4 | 67.3 | |
| 15 | 74.8 | 66.0 | | | | 72.9 | 72.7 | |
| 16 | 76.3 | 70.7 | | | System died 68.4 | 68.4 | 71.1 | |
| 17 | 73.3 | Jammed | 58.8 | | | 70.5 | 70.1 | |
| 18 | 78.3 | | 60.8 | | | | 67.8 | |
| 19 | 78.9 | | 63.7 | | | 65.5 | 66.9 | Landings |
| 20 | 82.1 | | 51.5 | | | | | |
| 21 | 76.3 | | 65.7 | | | 71.0 | | |
| 22 | 77.2 | | 64.8 | | | 70.4 | | |
| 23 | 79.9 | | 58.5 | | | 64.9 | | Landings |
| 24 | | | 42.8 | | | | | |
| DNL | 79.0 | 69.6 | | | 76.2 | 69.0 | | |
| CNEL | 79.8 | | | | | 69.2 | | |

TABLE B-1
HOURLY NOISE LEVELS (dB) AT HOMESTEAD AFB

| September 13 | | | | | September 14 | | | |
|--------------|--------------|--------------|--------------|-----------|--------------|--------------|--------------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Operation | Site 1 | Site 2 | Site 3 | Operation |
| 1 2 | | | | Landings | 49.2 50.4 | | 46.5 49.1 | Takeoffs |
| 3 4 | | | | | 55.9 49.0 | | 62.3 46.4 | |
| 5 6 | | | | | 48.9 56.7 | | 43.5 52.6 | |
| 7 8 | | 49.3 | | | 48.9 50.1 | | 47.7 52.3 | |
| 9 10 | | 49.3 70.4 | | Takeoffs | 46.5 76.4 | 70.6 | 41.7 53.0 | Landings |
| 11 12 | | 76.1 72.5 | | | 79.6 80.4 | 73.9 76.0 | 66.5 58.8 | |
| 13 14 | 75.3 79.6 | 68.1 76.7 | 67.1 57.9 | | 76.8 73.2 | 73.6 71.2 | 62.5 57.8 | |
| 15 16 | 77.8 81.9 | 68.7 69.4 | 69.2 69.7 | | 77.2 66.0 | 73.3 60.3 | 54.5 53.3 | |
| 17 18 | 74.1 68.5 | 71.2 62.6 | 62.2 57.0 | | 76.9 70.1 | 70.3 64.5 | 64.0 60.9 | |
| 19 20 | 77.8 77.9 | 71.0 68.1 | 67.3 71.1 | | 77.8 59.1 | 60.7 45.9 | 62.7 51.3 | |
| 21 22 | 74.7 59.7 | 60.8 50.2 | 71.0 66.1 | | 71.3 81.4 | 67.4 76.1 | 52.5 61.2 | |
| 23 24 | 61.8 51.1 | | 62.0 54.9 | | 71.6 57.7 | 67.4 | 53.2 47.0 | |
| DNL | 75.7 | | 68.9 | | 75.3 | 70.8 | 62.2 | |
| CNEL | 75.8 | | 69.0 | | 76.7 | 71.6 | 62.6 | |

TABLE B-1

HOURLY NOISE LEVELS (dB) AT HOMESTEAD AFB

| September 15 | | | | | September 16 | | | |
|--------------|--------|--------|--------|------------|--------------|--------|--------|------------|
| Hour | Site 1 | Site 2 | Site 3 | Operations | Site 1 | Site 2 | Site 3 | Operations |
| 1 | 59.9 | | 45.5 | Landings | 53.1 | | 44.8 | Landings |
| 2 | 70.4 | 62.4 | 47.9 | | 54.7 | | 45.4 | |
| 3 | 59.8 | | 46.6 | | 56.7 | | 45.9 | |
| 4 | 57.0 | | 49.3 | | 57.0 | | 45.8 | |
| 5 | 71.1 | 64.5 | 53.0 | | 52.6 | | 45.8 | |
| 6 | 56.0 | | 63.2 | | 56.9 | | 43.8 | |
| 7 | 50.5 | | 76.9 | | 48.9 | | 41.0 | |
| 8 | 64.4 | 54.0 | 37.5 | | 46.3 | | 40.1 | |
| 9 | 67.6 | 56.9 | 51.7 | | 55.3 | | 49.9 | |
| 10 | 66.4 | 61.6 | 54.8 | | 58.6 | 42.5 | 48.4 | |
| 11 | 65.1 | 61.2 | 48.6 | | 53.4 | 42.5 | 49.9 | |
| 12 | 59.0 | 49.6 | 46.4 | | 52.6 | | 60.9 | |
| 13 | 53.8 | | 56.8 | | 63.4 | 55.1 | 66.3 | |
| 14 | 52.9 | | 49.6 | | 53.1 | | 49.4 | |
| 15 | 54.7 | | 51.9 | | 53.4 | | 51.5 | |
| 16 | 56.1 | | 63.0 | | 50.3 | | 48.3 | |
| 17 | 78.5 | 68.7 | 66.7 | | 50.0 | | 45.8 | |
| 18 | 69.0 | 68.5 | 52.6 | | 75.7 | 72.0 | 56.6 | |
| 19 | 48.7 | | 44.4 | | 49.5 | | 47.3 | |
| 20 | 75.7 | 70.2 | 55.1 | | 71.6 | 64.2 | 47.4 | |
| 21 | 83.5 | 73.3 | 56.6 | | 69.8 | 65.8 | 46.9 | |
| 22 | 52.0 | | 43.1 | | 53.9 | | 44.0 | |
| 23 | 53.7 | | 43.4 | | 53.1 | | 47.3 | |
| 24 | 50.9 | | 44.9 | | 53.4 | | 44.9 | |
| DNL | 74.2 | 67.0 | 73.4 | | 65.9 | 61.6 | 56.1 | |
| CNEL | 76.8 | 68.2 | 73.4 | | 67.7 | 61.8 | 56.2 | |

TABLE B-1

HOURLY NOISE LEVELS (dB) AT HOMESTEAD AFB

| September 17 | | | | | September 18 | | | |
|--------------|--------|--------|--------|-----------|--------------|--------|-------------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Operation | Site 1 | Site 2 | Site 3 | Operation |
| 1 | 54.4 | | 45.5 | Landings | 54.8 | | 44.9 | Landings |
| 2 | 54.7 | | 45.1 | | 51.4 | | 44.8 | |
| 3 | 55.9 | | 45.6 | | 51.6 | | 46.4 | |
| 4 | 56.8 | | 46.1 | | 68.9 | 64.0 | 46.4 | |
| 5 | 52.9 | | 48.3 | | 50.8 | | 45.4 | |
| 6 | 52.4 | | 43.0 | | 51.2 | | 46.4 | |
| 7 | 51.4 | | 62.6 | | 52.7 | | 54.9 | |
| 8 | 63.9 | 61.0 | 40.2 | | 50.4 | | 69.2 | |
| 9 | 50.3 | | 41.4 | | 58.2 | 41.2 | 69.9 | |
| 10 | 68.4 | 66.8 | 64.4 | | 78.9 | 70.8 | 67.0 | |
| 11 | 74.4 | 72.3 | 63.7 | | 80.3 | 77.9 | NOISE-CHECK | |
| 12 | 76.6 | 73.8 | 65.6 | | 74.8 | 71.0 | | |
| 13 | 75.2 | 72.5 | 61.4 | | 67.9 | 63.7 | Unit | |
| 14 | 76.6 | 73.6 | 61.7 | | 71.3 | 68.5 | Stolen | |
| 15 | 64.4 | 58.5 | 66.1 | | 79.5 | 76.4 | | |
| 16 | 78.3 | 75.0 | 62.9 | | 62.1 | 59.9 | | |
| 17 | 70.9 | 65.0 | 68.0 | | 76.2 | 72.4 | | |
| 18 | 79.4 | 78.8 | 68.4 | | 72.8 | 66.2 | | |
| 19 | 63.3 | 32.9 | 72.5 | | 87.7 | 68.8 | | |
| 20 | 59.2 | | 68.9 | | 81.0 | 73.8 | | |
| 21 | 54.4 | | 66.1 | | 71.3 | 63.1 | | |
| 22 | 79.8 | 77.3 | 69.7 | | 69.9 | 65.4 | | |
| 23 | 56.1 | 47.6 | 49.6 | | 76.0 | 71.7 | | |
| 24 | 58.2 | 55.9 | 66.2 | | 56.1 | | | |
| DNL | 72.9 | 70.7 | 67.4 | | 78.3 | 72.3 | | |
| CNEL | 74.4 | 71.8 | 68.6 | | 79.9 | 72.6 | | |

TABLE B-1

HOURLY NOISE LEVELS (dB) AT HOMESTEAD AFB

| September 19 | | | | | September 20 | | | |
|--------------|--------|--------|--------|-----------|--------------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Operation | Site 1 | Site 2 | Site 3 | Operation |
| 1 | 70.8 | 64.3 | | Landings | 53.0 | | | |
| 2 | 53.8 | | | | 54.9 | | | |
| 3 | 59.0 | | | | 52.9 | | | |
| 4 | 54.3 | | | | 53.1 | | | |
| 5 | 51.0 | | | | 51.0 | | | |
| 6 | 49.6 | | | | 48.1 | | | |
| 7 | 48.7 | | | | 58.1 | | | |
| 8 | 50.9 | | | | 57.8 | 33.0 | | |
| 9 | 55.3 | | | | 71.3 | | | |
| 10 | 55.4 | | | | 73.8 | 59.9 | | |
| 11 | 76.7 | 62.0 | | | 70.9 | 59.4 | | |
| 12 | 72.4 | 70.1 | | | 75.7 | 71.7 | | |
| 13 | 77.6 | 75.5 | | | 70.8 | 71.1 | | |
| 14 | 82.9 | 75.4 | | | 76.9 | 72.4 | | |
| 15 | 64.8 | 40.8 | | | 61.8 | 59.4 | | |
| 16 | 73.8 | 74.5 | | | 69.8 | 60.9 | | |
| 17 | 78.6 | 74.4 | | | 74.3 | 69.3 | | |
| 18 | 78.7 | 75.1 | | | 75.1 | 72.3 | | |
| 19 | 63.1 | 53.4 | | | 59.1 | 65.2 | | |
| 20 | 57.1 | | | | 77.5 | 73.8 | | |
| 21 | 82.6 | 77.7 | | | 77.4 | 75.2 | | |
| 22 | 73.8 | 64.7 | | | 81.5 | 73.9 | | |
| 23 | 74.8 | 70.3 | | | 74.7 | 65.7 | | |
| 24 | 70.2 | 65.0 | | | 54.9 | 59.4 | | |
| DNL | 77.1 | 72.4 | | | 75.2 | 69.7 | | |
| CNEL | 78.4 | 73.4 | | | 77.4 | 71.9 | | |

AD-A113 672

AIR FORCE AEROSPACE MEDICAL RESEARCH LAB WRIGHT-PATT--ETC F/G 20/1
FIELD STUDIES OF THE AIR FORCE PROCEDURES (NOISECHECK) FOR MEAS--ETC(U)
MAR 82 R A LEE
AFAMRL-TR-82-12

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TABLE B-1

HOURLY NOISE LEVELS (dB) AT HOMESTEAD AFB

| September 21 | | | | | | | | |
|--------------|--------|--------|--------|-----------|--------|--------|--------|-----------|
| Hour | Site 1 | Site 2 | Site 3 | Operation | Site 1 | Site 2 | Site 3 | Operation |
| 1 | 54.8 | | | | | | | |
| 2 | 53.4 | | | | | | | |
| 3 | 51.5 | | | | | | | |
| 4 | 52.5 | | | | | | | |
| 5 | 56.5 | | | | | | | |
| 6 | 52.4 | | | | | | | |
| 7 | 54.4 | | | | | | | |
| 8 | 47.0 | | | | | | | |
| 9 | 57.9 | | | | | | | |
| 10 | 75.0 | 59.1 | | | | | | |
| 11 | 78.3 | 70.6 | | | | | | |
| 12 | 80.4 | 67.5 | | | | | | |
| 13 | 84.2 | 74.0 | | | | | | |
| 14 | 61.8 | 72.3 | | | | | | |
| 15 | 77.1 | 67.4 | | | | | | |
| 16 | 81.4 | 70.1 | | | | | | |
| 17 | 80.1 | 72.5 | | | | | | |
| 18 | 75.1 | 65.0 | | | | | | |
| 19 | 78.7 | 67.4 | | | | | | |
| 20 | 71.5 | 67.9 | | | | | | |
| 21 | 79.2 | 71.1 | | | | | | |
| 22 | 72.8 | 69.1 | | | | | | |
| 23 | 71.3 | 67.1 | | | | | | |
| 24 | 53.4 | 45.2 | | | | | | |
| DNL | 76.8 | 69.0 | | | | | | |
| CNEL | 77.6 | 70.1 | | | | | | |

TABLE B-2

WEATHER AT HOMESTEAD AFB

| | Sep 10 | | Sep 11 | | Sep 12 | | Sep 13 | | Sep 14 | | Sep 15 | | Sep 16 | |
|--------------|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|--------|----|
| Hour | °F | % | °F | % | °F | % | °F | % | °F | % | °F | % | °F | % |
| 1 | 82 | 79 | 79 | 88 | 81 | 79 | 79 | 88 | 75 | 94 | 82 | 82 | 81 | 79 |
| 2 | 82 | 79 | 79 | 83 | 81 | 79 | 80 | 83 | 78 | 88 | 80 | 88 | 81 | 77 |
| 3 | 82 | 79 | 80 | 85 | 77 | 91 | 76 | 88 | 76 | 94 | 80 | 88 | 80 | 79 |
| 4 | 81 | 82 | 80 | 85 | 77 | 88 | 77 | 85 | 76 | 94 | 80 | 88 | 80 | 79 |
| 5 | 81 | 82 | 81 | 85 | 76 | 90 | 79 | 83 | 76 | 94 | 77 | 91 | 80 | 79 |
| 6 | 81 | 82 | 78 | 88 | 78 | 90 | 78 | 88 | 75 | 94 | 77 | 91 | 80 | 79 |
| 7 | 81 | 82 | 79 | 85 | 79 | 88 | 79 | 85 | 75 | 94 | 77 | 91 | 80 | 79 |
| 8 | 81 | 82 | 80 | 85 | 78 | 90 | 80 | 82 | 74 | 94 | 79 | 84 | 81 | 77 |
| 9 | 82 | 79 | 80 | 85 | 82 | 82 | 81 | 79 | 76 | 88 | 81 | 82 | 82 | 75 |
| 10 | 82 | 79 | 83 | 72 | 83 | 76 | 82 | 79 | 80 | 82 | 83 | 77 | 84 | 69 |
| 11 | 83 | 77 | 85 | 72 | 83 | 77 | 84 | 75 | 82 | 80 | 84 | 77 | 84 | 69 |
| 12 | 84 | 75 | 85 | 72 | 85 | 72 | 84 | 75 | 79 | 82 | 84 | 77 | 84 | 69 |
| 13 | 84 | 75 | 89 | 72 | 85 | 72 | 85 | 72 | 82 | 77 | 85 | 72 | 85 | 70 |
| 14 | 84 | 75 | 85 | 72 | 85 | 70 | 84 | 72 | 83 | 77 | 85 | 72 | 85 | 70 |
| 15 | 84 | 75 | 85 | 72 | 85 | 70 | 85 | 75 | 83 | 74 | 84 | 72 | 86 | 68 |
| 16 | 84 | 75 | 86 | 70 | 83 | 74 | 84 | 75 | 83 | 74 | 83 | 74 | 85 | 69 |
| 17 | 83 | 77 | 85 | 72 | 83 | 74 | 83 | 77 | 83 | 74 | 84 | 72 | 84 | 72 |
| 18 | 82 | 79 | 84 | 75 | 83 | 74 | 83 | 74 | 82 | 77 | 83 | 74 | 84 | 72 |
| 19 | 82 | 79 | 83 | 74 | 82 | 77 | 82 | 77 | 82 | 77 | 79 | 82 | 83 | 74 |
| 20 | 82 | 79 | 82 | 77 | 81 | 79 | 81 | 79 | 82 | 75 | 78 | 76 | 82 | 76 |
| 21 | 82 | 79 | 82 | 77 | 80 | 82 | 80 | 82 | 82 | 77 | 79 | 82 | 82 | 76 |
| 22 | 82 | 79 | 82 | 79 | 80 | 82 | 81 | 79 | 81 | 82 | 80 | 79 | 82 | 76 |
| 23 | 81 | 82 | 77 | 85 | 79 | 85 | 78 | 82 | 81 | 85 | 80 | 79 | 82 | 76 |
| 24 | 80 | 85 | 81 | 79 | 79 | 85 | 76 | 91 | 81 | 82 | 80 | 79 | 81 | 79 |
| Ave | 82 | 79 | 82 | 79 | 81 | 80 | 81 | 80 | 79 | 84 | 81 | 80 | NA | |
| Ave (Ops) | 83 | 78 | 83 | 76 | 83 | 76 | 83 | 77 | 82 | 78 | 82 | 77 | NA | |

TABLE B-2

WEATHER AT HOMESTEAD AFB

| | Sep 17 | Sep 18 | Sep 19 | Sep 20 | Sep 21 | | |
|--------------|--------|--------|--------|--------|--------|--|-----------------|
| Hour | °F % | °F % | °F % | °F % | °F % | | °F % |
| 1 | 81 79 | 81 74 | 80 77 | 80 77 | 80 80 | | |
| 2 | 81 79 | 76 85 | 81 74 | 81 74 | 80 80 | | |
| 3 | 81 79 | 79 85 | 80 77 | 80 77 | 81 82 | | |
| 4 | 80 82 | 79 85 | 80 77 | 80 77 | 81 82 | | |
| 5 | 80 82 | 79 85 | 80 77 | 80 77 | 81 82 | | |
| 6 | 80 82 | 80 82 | 80 77 | 80 77 | 81 82 | | |
| 7 | 80 82 | 80 82 | 80 77 | 80 77 | 81 82 | | |
| 8 | 81 79 | 80 82 | 80 77 | 81 74 | 81 82 | | |
| 9 | 83 74 | 82 77 | 82 72 | 82 72 | 83 77 | | |
| 10 | 84 72 | 84 72 | 83 70 | 83 70 | 83 77 | | |
| 11 | 84 72 | 84 72 | 84 67 | 84 68 | 84 74 | | |
| 12 | 85 70 | 85 70 | 85 65 | 85 68 | 86 70 | | |
| 13 | 85 70 | 86 68 | 85 65 | 85 68 | 87 68 | | |
| 14 | 86 67 | 86 68 | 85 65 | 85 70 | 86 68 | | |
| 15 | 84 72 | 85 68 | 85 68 | 85 68 | 85 72 | | |
| 16 | 85 70 | 84 70 | 84 70 | 85 70 | 85 70 | | |
| 17 | 84 72 | 85 68 | 84 70 | 84 72 | 84 74 | | |
| 18 | 83 74 | 84 70 | 83 70 | 80 82 | 83 77 | | |
| 19 | 82 77 | 82 75 | 82 72 | 81 80 | 83 77 | | |
| 20 | 81 79 | 81 75 | 81 74 | 82 75 | 82 79 | | |
| 21 | 82 77 | 81 75 | 81 74 | 81 77 | 81 82 | | |
| 22 | 82 77 | 81 75 | 81 74 | 82 75 | 81 82 | | |
| 23 | 77 82 | 81 74 | 81 74 | 79 82 | 81 82 | | |
| 24 | 72 88 | 81 74 | 80 77 | 80 79 | 81 82 | | BUSY DAY AVE |
| Ave | 82 77 | 82 75 | 82 73 | 82 74 | 83 78 | | 82 78 |
| Ave (Ops) | 84 73 | 84 71 | 83 70 | 83 73 | 84 75 | | 83 75 |

TABLE B-3

OPERATIONS LOGGED BY BASE OPERATIONS
AT HOMESTEAD AFB FL

| Base Operations ID | PA | SA | TA | VI | PSG | ILS | ARA | VA |
|-------------------------|---|-------|------|-------|----------------|----------------|----------------|----------------|
| NOISEMAP Fit Tracks | 05E1 | 05J1* | 05F1 | 05G1* | 05E1** | 05E1 | 05E1 | 05G1 |
| Sept 11 | 28 | 18 | 10 | 24 | 16 | 0 | 4 | 2 |
| 12 | Aircraft Did Takeoff Operations Over Microphone Locations | | | | | | | |
| 13 | Aircraft Did Takeoff Operations Over Microphone Locations | | | | | | | |
| 14 | 49 | 8 | 6 | 15 | 3 | 0 | 0 | 0 |
| Sat 15 | 6 | 3 | 1 | 0 | 1 | 3 | 0 | 0 |
| Sun 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 25 | 1 | 1 | 10 | 9 | 4 | 1 | 0 |
| 18 | 25 | 9 | 0 | 20 | 3 | 1 | 1 | 1 |
| 19 | 50 | 1 | 2 | 22 | 6 | 0 | 0 | 1 |
| 20 | 53 | 1 | 3 | 14 | 2 | 0 | 0 | 1 |
| 21 | 38 | 8 | 0 | 19 | 0 | 0 | 0 | 0 |
| Total | 274 | 49 | 23 | 124 | 40 | 8 | 6 | 5 |
| Av Busy Day (9 Days) | 36.44 | 5.44 | 2.56 | 14.33 | Added to PA | Added to PA | Added to PA | Added to VI |
| NOISEMAP | 22.42 | 18.38 | 4.43 | 25.71 | | | | |

* NOISEMAP coded for pitch-out approach

** Slight variation of this flight track

TABLE B-4

F-4 AIRCRAFT PARAMETERS FROM STANDARD EVALUATION
AT HOMESTEAD AFB FL

| F-4 Parameters | Stan-Eval Site 1 | NOISEMAP Input Site 1 | Stan-Eval Site 2 | NOISEMAP Input Site 2 |
|-------------------|---------------------|-----------------------------|---------------------|-----------------------------|
| % RPM | 84% - 85% | 87% | 83% - 88% | 87% |
| Airspeed | 160 Kts | 190 Kts | 230 - 160 Kts | 190 Kts |
| Altitude | 500 ft | 536 ft | 1200 ft | 1196 ft |

TABLE B-5

SLANT DISTANCE TO FLIGHT TRACK
AT HOMESTEAD AFB FL (In Feet)

| | PA | SA | TA | ARA | VI | ILS | PSG |
|-------------------------|-------------|-------------|-------------|------------|-------------|------------|-------------|
| Site 1 | | | | | | | |
| Number of Samples | 12 | 2 | 0 | 2 | 0 | 3 | 3 |
| Average Slant Dist. | 616 ft | 652 ft | | 683 ft | | 575 ft | 623 ft |
| Standard Deviation | <u>+81</u> | <u>+16</u> | | <u>+44</u> | | <u>+98</u> | <u>+24</u> |
| NOISEMAP Slant Dist. | 536 ft | 493 ft | | 536 ft | | 536 ft | 536 ft |
| Site 2 | | | | | | | |
| Number of Samples | 28 | 4 | 5 | 0 | 18 | 0 | 6 |
| Average Slant Dist. | 1306ft | 1299ft | 2072ft | | 1649ft | | 1462ft |
| Standard Deviation | <u>+135</u> | <u>+406</u> | <u>+420</u> | | <u>+265</u> | | <u>+365</u> |
| NOISEMAP Slant Dist. | 1196ft | 2000ft | 2356ft | | 4357ft | | 1196ft |

APPENDIX C

RANK ORDERING OF DNL CONTRIBUTORS AT A SITE
FROM THE NOISECHECK PROCEDURES REPORT

DETERMINING MAJOR CONTRIBUTORS TO NOISEMAP DNL VALUES AT SPECIFIC SITES

NOISECHECK procedures rely on limited analysis of the aircraft noise information used by NOISEMAP to (1) predict the SEL at a point for comparison with measurements at that point and (2) determine the operations that contribute significantly to exposure at a point. This procedure requires accurate reconstruction of aircraft flight profiles from NOISEMAP chronicles to estimate NOISEFILE SEL values.

NOISEFILE SEL VALUES

Nominal SEL values for most military aircraft have been determined as a function of slant distance. The compilation of these data is called NOISEFILE. The data are available as computer tape files* and in Air Force Report AMRL TR-73-110, "Community Noise Exposure Resulting from Aircraft Operations: Acoustic Data on Military Aircraft" (1977). This report presents noise level vs distance data for takeoff power, cruise power, and approach power for each aircraft. Additional listings are presented for special power settings, such as afterburner and water injection. The report also presents an SEL adjustment for power settings and speeds that are not identical to the nominal values. Note: This report, AFAMRL-TR-73-110 was published before the sound duration algorithm was changed from $10 \log (D_1/D_2)$ to $6 \log (D_1/D_2)$. The corrections to be applied to the SEL values are in an errata sheet that was published later.

NOISEMAP AIRCRAFT OPERATIONAL PARAMETERS - GENERAL

Operational input information describing each individual aircraft mission is listed in the NOISEMAP chronicles and DATASCREEN summaries. The number of operations for each is summarized, but other parameters appear in the chronicles in the order in which the input data package was assembled. The parameters used to reconstruct NOISEMAP SEL values are:

- Flight tracks
- Altitude profile
- Delta SEL.

*Contact the Air Force Aerospace Medical Research Laboratory, Biodynamic Environment Branch, Wright-Patterson Air Force Base, Ohio 45433.

DETERMINATION OF SELs AT A SITE

Two types of worksheets are used to determine SELs at a site. Worksheet 7 provides a summary of NOISEFILE data. Worksheet 8 consolidates the information for a particular aircraft and operation (e.g., KC-135A, pattern) and yields the SELs at sites of interest.

STEP-BY-STEP ESTIMATION OF NOISEFILE SEL VALUES

- I. Use Worksheet 7 to list SEL data from Air Force Report AMRL TR-73-110 that is pertinent to each aircraft and mission. (See filled-in example in Figure C-1.)
 - A. Enter operations type for the aircraft tabulated at top of table (e.g., operation/power settings: TAKEOFF in Figure C-1).
 - B. Enter aircraft type in first row of table. (There may be multiple entries because of different varieties of takeoff procedures, for example.)
 - C. Enter the pertinent aircraft code (ACC) and operations code (OPC) in Row 2 (e.g., 026/102 in second column of Figure C-1).
 - D. Enter the corresponding power setting for the operations in percent, engine rpm, and/or exhaust pressure rating (EPR) in Row 3 (e.g., 96%/2.85 in second column of Figure C-1).
 - E. Enter the corresponding airspeed (knots) in Row 4 (e.g., 200).
 - F. Enter the SEL (dB) tabulation as a function of the slant distance tabulated with the left-hand column. Note: Summaries of both air-to-ground and ground-to-ground are required.
- II. Complete a Worksheet 8 to include altitudes, lateral distances, NOISEFILE SELs, Delta-SEL profiles, and numbers of operations for each aircraft in the NOISEMAP chronicle that could affect the measurement sites.

Measurement Program _____
 Sheet _____ of _____
 Engineer _____
 Date _____

Air-To-Ground Propagation, Operation/Power Setting: TAKEOFF

| A/C Type | KC135A | KC135A | B526 | A-37 | T-37 | T-38 | T-38 | T-39 | C-130A |
|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| ACC/OPC | 024/102 | 016/103 | 043/103 | 504/103 | 034/103 | 033/101 | 033/103 | 013/103 | 006/103 |
| RPM/EPR | 115.55 | 115.45 | 115.37 | 100 | 99 | 100 | 100 | 100 | 16800 |
| Knots | 200 | 200 | 170 | 300 | 170 | 300 | 300 | 180 | 170 |
| 200 | 128.6 | 126.9 | 129.9 | 115.2 | 107.2 | 123.8 | 115.1 | 112.4 | 93.3 |
| 250 | 127.1 | 125.6 | 128.6 | 113.9 | 106.0 | 122.0 | 113.9 | 111.1 | 97.2 |
| 315 | 125.6 | 124.2 | 127.4 | 112.7 | 104.8 | 120.1 | 112.6 | 109.9 | 96.1 |
| 400 | 124.2 | 122.8 | 126.1 | 111.3 | 103.6 | 118.3 | 111.3 | 108.6 | 94.9 |
| 500 | 122.7 | 121.4 | 124.7 | 110.0 | 102.2 | 116.4 | 109.9 | 107.3 | 93.7 |
| 630 | 121.2 | 120.0 | 123.3 | 108.5 | 100.9 | 114.6 | 108.5 | 105.9 | 92.4 |
| 800 | 119.8 | 118.5 | 121.9 | 107.0 | 99.4 | 112.9 | 107.0 | 104.4 | 91.1 |
| 1000 | 118.2 | 117.0 | 120.4 | 105.4 | 97.9 | 111.2 | 105.4 | 102.9 | 89.8 |
| 1250 | 116.6 | 115.5 | 118.8 | 103.7 | 96.3 | 109.5 | 103.6 | 101.3 | 88.4 |
| 1600 | 115.0 | 113.8 | 117.1 | 101.9 | 94.6 | 107.8 | 101.8 | 99.6 | 86.9 |
| 2000 | 113.2 | 112.1 | 115.3 | 99.9 | 92.8 | 106.0 | 99.9 | 97.8 | 85.4 |
| 2500 | 111.4 | 110.3 | 113.4 | 97.8 | 90.9 | 104.0 | 97.8 | 95.8 | 83.8 |
| 3150 | 109.4 | 108.4 | 111.4 | 95.6 | 88.9 | 102.0 | 95.6 | 93.8 | 82.1 |
| 4000 | 107.3 | 106.4 | 109.3 | 93.2 | 86.7 | 99.9 | 93.2 | 91.6 | 80.4 |
| 5000 | 105.0 | 104.2 | 107.0 | 90.6 | 84.4 | 97.6 | 90.6 | 89.3 | 79.5 |
| 6300 | 102.6 | 101.9 | 104.5 | 87.9 | 81.9 | 95.2 | 87.9 | 86.9 | 78.5 |
| 8000 | 100.0 | 99.4 | 101.9 | 84.9 | 79.2 | 92.5 | 85.0 | 84.2 | 74.3 |
| 10000 | 97.2 | 96.7 | 99.1 | 81.8 | 76.2 | 89.6 | 81.8 | 81.4 | 72.1 |
| 12500 | 94.1 | 93.8 | 96.0 | 78.4 | 73.0 | 86.5 | 78.4 | 78.3 | 69.8 |
| 16000 | 90.9 | 90.7 | 92.8 | 74.7 | 69.6 | 83.2 | 74.8 | 75.1 | 67.4 |
| 20000 | 87.4 | 87.3 | 89.2 | 70.9 | 65.7 | 79.6 | 71.0 | 71.6 | 65.1 |
| 25000 | 83.6 | 83.7 | 85.4 | 66.8 | 61.6 | 75.8 | 66.9 | 67.4 | 62.7 |

Ground-To-Ground Propagation, Operation/Power Setting:

| A/C Type | KC135 | KC135 | B526 | A-37 | T-37 | T-38 | T-38 | T-39 | C-130A |
|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| ACC/OPC | 024/102 | 026/103 | 043/103 | 504/103 | 034/103 | 023/101 | 013/103 | 013/103 | 006/103 |
| RPM/EPR | 115.55 | 115.45 | 115.37 | 100 | 99 | 100 | 100 | 100 | 16800 |
| Knots | 200 | 200 | 170 | 300 | 170 | 300 | 300 | 180 | 170 |
| 200 | 123.6 | 121.9 | 124.9 | 110.2 | 102.2 | 118.8 | 110.1 | 107.4 | 93.3 |
| 250 | 122.1 | 120.6 | 123.6 | 108.9 | 101.0 | 117.0 | 108.9 | 106.1 | 92.2 |
| 315 | 120.6 | 119.2 | 122.4 | 107.7 | 99.8 | 115.1 | 107.6 | 104.9 | 91.1 |
| 400 | 119.1 | 117.8 | 121.1 | 106.3 | 98.6 | 113.3 | 106.3 | 103.6 | 89.9 |
| 500 | 117.7 | 116.4 | 119.7 | 105.0 | 97.2 | 111.4 | 104.9 | 102.2 | 88.7 |
| 630 | 116.2 | 114.9 | 118.3 | 103.5 | 95.9 | 109.6 | 103.5 | 100.8 | 87.4 |
| 800 | 114.6 | 113.5 | 116.8 | 102.0 | 94.4 | 107.9 | 102.0 | 99.4 | 86.1 |
| 1000 | 113.1 | 111.9 | 115.3 | 100.4 | 92.9 | 106.2 | 100.3 | 97.8 | 84.7 |
| 1250 | 111.3 | 110.3 | 113.7 | 98.7 | 91.2 | 104.4 | 98.6 | 96.2 | 83.2 |
| 1600 | 109.5 | 108.5 | 112.0 | 96.8 | 89.5 | 102.6 | 96.8 | 94.4 | 81.6 |
| 2000 | 107.6 | 106.7 | 110.1 | 94.8 | 87.6 | 100.7 | 94.8 | 92.6 | 79.9 |
| 2500 | 105.3 | 104.5 | 108.1 | 92.7 | 85.5 | 98.6 | 92.6 | 90.4 | 77.9 |
| 3150 | 102.6 | 102.1 | 105.8 | 90.3 | 83.2 | 96.2 | 90.2 | 88.0 | 75.6 |
| 4000 | 99.4 | 99.2 | 103.1 | 87.6 | 80.4 | 93.5 | 87.6 | 85.3 | 73.0 |
| 5000 | 95.7 | 95.8 | 100.0 | 84.5 | 77.2 | 90.2 | 84.4 | 82.1 | 70.0 |
| 6300 | 91.5 | 92.0 | 96.5 | 81.0 | 73.6 | 86.6 | 81.0 | 78.5 | 66.7 |
| 8000 | 87.8 | 88.7 | 93.3 | 77.6 | 70.3 | 83.3 | 77.5 | 75.2 | 63.7 |
| 10000 | 83.7 | 85.0 | 89.7 | 73.7 | 66.6 | 79.6 | 73.7 | 71.4 | 60.4 |
| 12500 | 79.1 | 80.8 | 85.7 | 69.5 | 62.5 | 75.4 | 69.5 | 67.3 | 56.8 |
| 16000 | 73.9 | 76.2 | 81.3 | 64.7 | 57.9 | 70.7 | 64.7 | 62.7 | 52.7 |
| 20000 | 68.3 | 71.1 | 76.4 | 59.4 | 52.7 | 65.4 | 59.4 | 57.5 | 48.5 |
| 25000 | 62.3 | 65.4 | 70.8 | 53.4 | 46.9 | 59.5 | 53.5 | 51.8 | 44.2 |

*Values listed do not reflect the NOISEFILE revision made in February 1980 for an improved model of sound duration as function of propagation distance.

FIG. C-1. EXAMPLE OF COMPLETED NOISEFILE SEL SUMMARY (59°F, 70% R.H.) (WORKSHEET 7).

- A. Search chronicles for listings such as that shown below and, for each A/C type and operation, transfer the altitude profile (ALT PROF) and power profile (POW PROF) pertinent to each mission number. Transfer also the noise profile (NOISE PROF) appropriate to each site that is within the prescribed flight track limits.

Takeoff Descriptor Class No. - 261 A/C-KC-135A

Mission No. - 2

ALT PROF - 2612

POW PROF - 2612

TURN RAD - 6000.0 ft

| SUBFLIGHT NOISE PROF | | TRACK LIMITS (FT) | |
|----------------------|-----|-------------------|-------------|
| 1 | 262 | 0.0 to | 27,000.0 |
| 2 | 263 | 27,000.0 to | 1,000,000.0 |

- B. From the Flight Operations Summary by Aircraft in the NOISEMAP chronicles, enter, for the aircraft selected, the total of day and night numbers of operations for the listed operation and mission number appropriate to the flight tracks near the measurement sites. For example, in the KC-135A summary from the NOISEMAP chronicle shown in Fig. C-2, the measurement sites nearer to Runway 14 are identified by mission number, and only numbers of approach operations near the measurement sites must be extracted because of this site/runway configuration. However, for sites nearer Runway 32, the daytime number of straight-out takeoffs for mission No. 2 would be $0.120 + 0.901 + 0.720 + \dots = 2.581$. cursory examination of the chronicles of individual ALT and POW profiles pertinent to missions 31 through 35 (for the KC-135A) shows that their profiles (see Fig. C-2) are identical. Furthermore, description (by runway number) in the chronicles of the flight tracks for these missions indicates that all of these missions are pattern flights (see Fig. C-2). Thus, the sum (8.602) of the individual daytime operations is entered for KC-135A approach pattern missions 31 through 35 over sites closer to Runway 14.

KC-135A AIRCRAFT

| NAME | NO | MSN | FLIGHT TRACK CODE | NUMBER OF OPERATIONS | | AIRCRAFT OPERATIONS |
|--------------|------|------|-------------------|----------------------|-----------|---------------------|
| | | | | 0701-2200 | 2201-0700 | |
| K135A 43 | 0261 | 0023 | 14B3 | 3.810 | 1.320 | 16.2 % |
| K135A C1 | 0261 | 0031 | 14CF | .461 | .135 | 3.1 % |
| K135A C2 | 0261 | 0032 | 14CG | 1.720 | .270 | 6.3 % |
| K135A C3 | 0261 | 0033 | 14CH | 3.440 | .540 | 12.6 % |
| K135A C4 | 0261 | 0034 | 14CI | 1.720 | .270 | 6.3 % |
| K135A C5 | 0261 | 0035 | 14CJ | .861 | .135 | 3.1 % |
| KC-135A | 0261 | 0010 | 14E | 3.180 | .510 | 5.8 % |
| KC-135A | 0261 | 0002 | 104 | .120 | .020 | .2 % |
| KC-135A | 0261 | 0003 | 104 | .030 | .005 | .1 % |
| KC-135A | 0261 | 0002 | 83 | .901 | .140 | 1.6 % |
| KC-135A | 0261 | 0003 | 83 | .210 | .030 | .4 % |
| KC-135A | 0261 | 0002 | 88 | .720 | .110 | 1.3 % |
| KC-135A | 0261 | 0003 | 88 | .159 | .030 | .3 % |
| KC-135A | 0261 | 0002 | 93 | .120 | .020 | .2 % |
| KC-135A | 0261 | 0003 | 93 | .030 | .005 | .1 % |
| KC-135A | 0261 | 0002 | 98 | .720 | .110 | 1.3 % |
| KC-135A | 0261 | 0003 | 98 | .159 | .030 | .3 % |
| TOTAL RUNWAY | | | 14 | 15.581 | 3.170 | |
| | | | TAKEOFFS | 15.581 | 3.170 | |
| | | | LANDINGS | 15.592 | 3.180 | |
| | | | OPERATIONS | 37.523 | | 59.3 |

(A) KC-135A SUMMARY NUMBER OF OPERATIONS

| +++ ALTITUDE PROFILE | | NAME = | 26131 |
|-----------------------|----------------|--------|---------------|
| TRACK DIST | ALTITUDE | | |
| 0. FT | 0. FT | | |
| 4500. FT | 0. FT | | |
| 4500. FT | 200. FT | | |
| 23500. FT | 1700. FT | | |
| 208300. FT | 1700. FT | | |
| 247300. FT | 0. FT | | |
| +++ DELTA-SEL PROFILE | | NAME = | 26131 K135 C1 |
| TRACK DIST | REL POWER (DB) | | |
| 0. FT | 6.9 | | |
| 10000. FT | 6.9 | | |
| 18000. FT | -7.4 | | |
| 19000. FT | -3.4 | | |
| 207000. FT | -3.4 | | |
| 208000. FT | -2.5 | | |

(B) ALTITUDE AND DELTA-SEL PROFILES

| | | | |
|---------------|-----------|-------------------|-----------------------|
| +++ TAKE-OFFS | | FLIGHT TRACK | 32CF |
| PROCEED | 31000. FT | WITH | 6000. FT RADIUS |
| TURN RIGHT | 90.0 DEG | WITH | 6000. FT RADIUS |
| PROCEED | 13800. FT | WITH | 6000. FT RADIUS |
| TURN RIGHT | 90.0 DEG | WITH | 6000. FT RADIUS |
| PROCEED | 91000. FT | WITH | 6000. FT RADIUS |
| TURN RIGHT | 90.0 DEG | WITH | 6000. FT RADIUS |
| PROCEED | 13800. FT | WITH | 6000. FT RADIUS |
| TURN RIGHT | 90.0 DEG | WITH | 6000. FT RADIUS |
| PROCEED | 60000. FT | | |
| | | FLIGHT OPERATIONS | - TRACK 32CF |
| | | A/C NO MISSION | - 0701-2200 2201-0700 |
| +++ K135A C | 026 | 31 | .570 .090 |

(C) DESCRIPTIONS BY RUNWAY

FIG. C-2. EXAMPLE FROM NOISEMAP CHRONICLE (KC-135A).

- C. Prepare a map showing runways, measurement sites, and flight tracks for missions.
- D. Indicate altitudes for each mission.
- E. Draw lines through each site and perpendicular to the flight track.
- F. Enter down-range distance from start of takeoff roll, altitude, and perpendicular distance in Worksheet 9.
- G. Using Eq. 1 in the supplement to Worksheet 8, calculate the slant distance from the perpendicular distances and the altitudes and enter in Worksheet 8.

Note: An altitude profile code of "φ" indicates that the profile is that of the glide slope for that runway and assumes that the aircraft is 50 ft above the runway at its threshold. The glide slope is listed in the chronicles within the runway description immediately following the runway number heading, as shown below.

```

***
-----
R U N W A Y      14
-----
LENGTH 11829.4 FT, GL. SLOPE 2.50 DEG. HEADING 144.6 DEG
START (1539610.0, 674620.0), FNO (1644320.0, 664260.0)
DISPLACEMENTS - TAKEOFF 0.0, LANDING 0.0
*****

```

- H. Consolidate onto one sheet (for a given aircraft type) any grouping of ALT and POW profile numbers which, while different in number, are identical in actual profile.
- I. From the NOISEMAP chronicle, enter the Delta-SEL profile data corresponding to the appropriate down-range distance.
- J. Enter the Noise Profile pertinent to each site by referring to the track limits and corresponding noise profile in the chronicles.

- K. Using Eq. 2 in the supplement to Worksheet 8, calculate the angle above the horizon, β . If angle β from any site is less than 7° , enter this in parentheses beside the Noise Profile Code for that site.
- L. Calculate the NOISEFILE SEL and A/C SEL for each site, given the Noise Profile Delta-SEL on the sheet and the ACC/OPC Codes from Worksheet 7.
1. For 3-digit Noise Profile Codes, the 2 left-most digits of the Noise Profile Code are the 2 right-most digits of the ACC Code. The right-most digit of the Noise Profile Code is the right-most digit of the OPS Code. Enter the NOISEFILE SEL Summary (Worksheet 7), and select the appropriate column (from the ACC/OPC Code shown).
 2. For Noise Profile Codes with more than 3 digits, the corresponding ACC and OPC Codes are similarly extracted; for nonobvious contractions or relationships, refer to the code numbers in Appendix B of Air Force Report AMRL TR-73-110. From the code numbers shown therein and their corresponding air speeds (knots) and Power Conditions (rpm/EPR), cross-check to the appropriate column already generated in the NOISEFILE SEL Summary, Worksheet 7.
 3. Given the slant distance appropriate to each aircraft and site, find the NOISEFILE SEL from the appropriate column(s) by the formula:

$$SEL = SEL_{G-G} \text{ for } \beta \leq 4^\circ$$

$$SEL = SEL_{G-G} + \frac{(SEL_{A-G} - SEL_{G-G}) \times (\beta - 4)}{3}$$

$$\text{for } 4^\circ \leq \beta \leq 7^\circ$$

$$SEL = SEL_{A-G} \text{ for } \beta \geq 7^\circ$$

- i. For interpolation at distance D_x between shorter distance D_1 listed and greater distance D_2 listed, use the formula:

$$SEL_x = SEL_1 - (SEL_1 - SEL_2) \frac{\log(D_x/D_1)}{\log(D_2/D_1)} .$$

- ii. Tabulate on Worksheet 9 the NOISEFILE SEL values thus determined for each site, add the corresponding Delta-SEL corrections to yield the A/C SEL, and enter these also on Worksheet 8.

This concludes the procedure for estimating the SEL at a point from analysis of NOISEMAP and NOISEFILE data. This "NOISEFILE SEL" may be used three times during NOISECHECK: (1) to estimate the "partial DNL" from individual types of operations at a site so that the relative importance of various operations can be assessed during the planning phase (Worksheet 9)

(2) to estimate the variance of NOISEMAP during data analysis (Worksheet 5); and (3) to seek out reasons why values of DNL from measurements differ from NOISEMAP values of DNL.

Step-by-Step Procedure to Determine the Significant Contributors to DNL at a Site

1. Complete headings for program, site, engineer, and date.
2. From Worksheet 8, transfer the following data for this site: aircraft, operation, mission number, aircraft SEL, and numbers of operations.
3. Using Eq. 1 in the supplement to Worksheet 9, calculate the effective number of operations for each operation and enter on Worksheet 9.
4. Using Eq. 2, calculate the partial DNL for each operation.
5. Rank order operations in terms of decreasing DNL.
6. Using Eq. 3, list "total DNL through rank" for each operation (i.e., for the operation ranked 2, this is $DNL_1 + DNL_2$, and for the operation ranked 3, this is $DNL_1 + DNL_2 + DNL_3$, etc.) until the total is within 0.3 dB of the NOISEMAP DNL for this site.

7. All operations contributing to this total should be considered significant contributors to the site DNL. SEL data should be obtained for these operations during NOISECHECK.

APPENDIX D

BLANK WORKSHEETS AND SUPPLEMENTAL EQUATIONS

[illegible]

- $$(4) \text{ Adjustment} = -10 \log \frac{\text{Effective No. of Oper.}}{\text{NOISEMAP}} \frac{\text{Effective No. of Oper.}}{\text{Effective No. of Oper.}}$$

| Calculated | |
|-------------------------------|--------------------|
| Measurement Std. Deviation | Measurement DNL |
| | |

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SUPPLEMENT TO WORKSHEET 1

1. The background Day-Night-Level, DNL(BG), can be estimated from:

$$DNL(BG) = 10 \log \left\{ \left[(15 \text{ antilog } \bar{L}_{h_d}/10) + (90 \text{ antilog } \bar{L}_{h_n}/10) \right] / 24 \right\},$$

where \bar{L}_{h_d} is the energy average daytime hour without aircraft noise,

and \bar{L}_{h_n} is the energy average nighttime hour without aircraft noise.

2. For each day

$$DNL' = 10 \log \left\{ \text{antilog } DNL/10 - \text{antilog } DNL(BG)/10 \right\}.$$

3. The energy average Day-Night Level, DNL(M) is:

$$DNL(M) = 10 \log \left[\left(\sum_{i=1}^m \text{antilog } DNL'_i/10 \right) / m \right],$$

where m is the number of adjusted daily DNLs on Worksheet 6.

4. The standard deviation for $(\text{antilog } \overline{DNL}/10)$ is:

$$\sigma_M = \sqrt{\frac{1}{m-1}} \left\{ \sum_{i=1}^m \left[\text{antilog}(DNL'_i/10) \right]^2 - \left[\sum_{i=1}^m \text{antilog}(DNL'_i/10) \right]^2 / m \right\}.$$

5. The confidence intervals about the \overline{DNL} are:

$$c.i. = 10 \log \left[\text{antilog}(\overline{DNL}/10) \pm z_c \frac{\sigma_M}{\sqrt{m}} \right].$$

For a 90% confidence interval, $z_c = 1.645$; for a 95% confidence interval, $z_c = 1.960$.

WORKSHEET 2

Engineer _____
Measurement Date _____

[illegible]

FIG. D-2. NOISE LEVEL LOG (WORKSHEET 2).

WORKSHEET 3

Measurement Program _____ Sheet _____ of _____

Site Number _____

Engineer _____

Measurement Date _____

[illegible]

FIG. D-3. SEL COMPUTATION SHEET (WORKSHEET 3).

SUPPLEMENT TO WORKSHEET 3

1. Energy average noise level of aircraft and operation i:

$$\overline{\text{SEL}}_i = 10 \log \left[\frac{1}{n_i} \sum_{k=1}^{n_i} \text{antilog} (\text{SEL}_k/10) \right].$$

2. Energy standard deviation for aircraft and operation i:

$$\sigma_i = \sqrt{\frac{1}{n_i-1} \left\{ \sum_{k=1}^{n_i} \left[\text{antilog}(\text{SEL}_k/10) \right]^2 - \left[\sum_{k=1}^{n_i} \text{antilog}(\text{SEL}_k/10) \right]^2 / n_i \right\}}.$$

3. Confidence interval (c.i.) for aircraft and operation i:

$$\text{c.i.} = 10 \log \left[\text{antilog} (\overline{\text{SEL}}_i/10) \pm z_c \frac{\sigma_i}{\sqrt{n_i}} \right].$$

For a 90% confidence interval, $z_c = 1.645$; for a 95% confidence interval, $z_c = 1.960$.

SUPPLEMENT TO WORKSHEET 4

1. DNL based on the adjusted energy average SELs:

$$\text{DNL}(S) = 10 \log \left[\sum_{i=1}^{n_j} N_i \text{antilog} (\overline{\text{SEL}}_i / 10) \right] - 49.4.$$

2. The standard deviation for antilog DNL(S)/10 is:

$$\sigma_s = \left(\sqrt{\sum_{i=1}^{n_j} N_i^2 \sigma_i^2} \right) \frac{1}{86,400}$$

3. The confidence intervals (c.i.) about the DNL are:

$$\text{c.i.} = 10 \log \left[\text{antilog} (\text{DNL}(S) / 10) \pm z_c \sqrt{\sum_{i=1}^n N_i^2 \sigma_i^2 / n} \right]$$

or

$$\text{c.i.} = 10 \log \left[\text{antilog} (\text{DNL}(S) / -10) \pm z_c \sigma_s / \sqrt{n} \right]$$

For a 90% confidence interval, $z_c = 1.645$; for a 95% confidence interval, $z_c = 1.960$.

(Note: The confidence intervals, expressed in dB, will not be equal.)

[illegible]

NOISEMAP DNL _____
Calculated σ _____
90% c.i. { (+) _____
(-) _____

FIG. D-5. CALCULATE THE NOISEMAP CONFIDENCE INTERVALS AND STANDARD DEVIATION (WORKSHEET 5).

SUPPLEMENT TO WORKSHEET 5

1. The estimated standard deviation associated with each operation for which an SEL is listed on Worksheet 5 is:

$$\sigma_i = N_i \left(\text{antilog} ((\text{SEL}_i + \sqrt{\text{VARIANCE}}) / 10) - \text{antilog} (\text{SEL}_i / 10) \right)$$

2. The estimated standard deviation associated with antilog (DNL(C)/10) is:

$$\sigma_c = \frac{\sqrt{\sum_{i=1}^{\ell} \sigma_i^2}}{86,400}.$$

3. The estimated confidence intervals about the NOISEMAP computed DNL value are:

$$\text{c.i.} = 10 \log \left[\text{antilog}(\text{DNL}(C)/10) \pm z_c \sigma_c / \sqrt{\ell} \right],$$

where ℓ is the number of SELs listed on Worksheet 5.

For a 90% confidence interval $z_c = 1.645$; for a 95% confidence interval, $z_c = 1.960$.

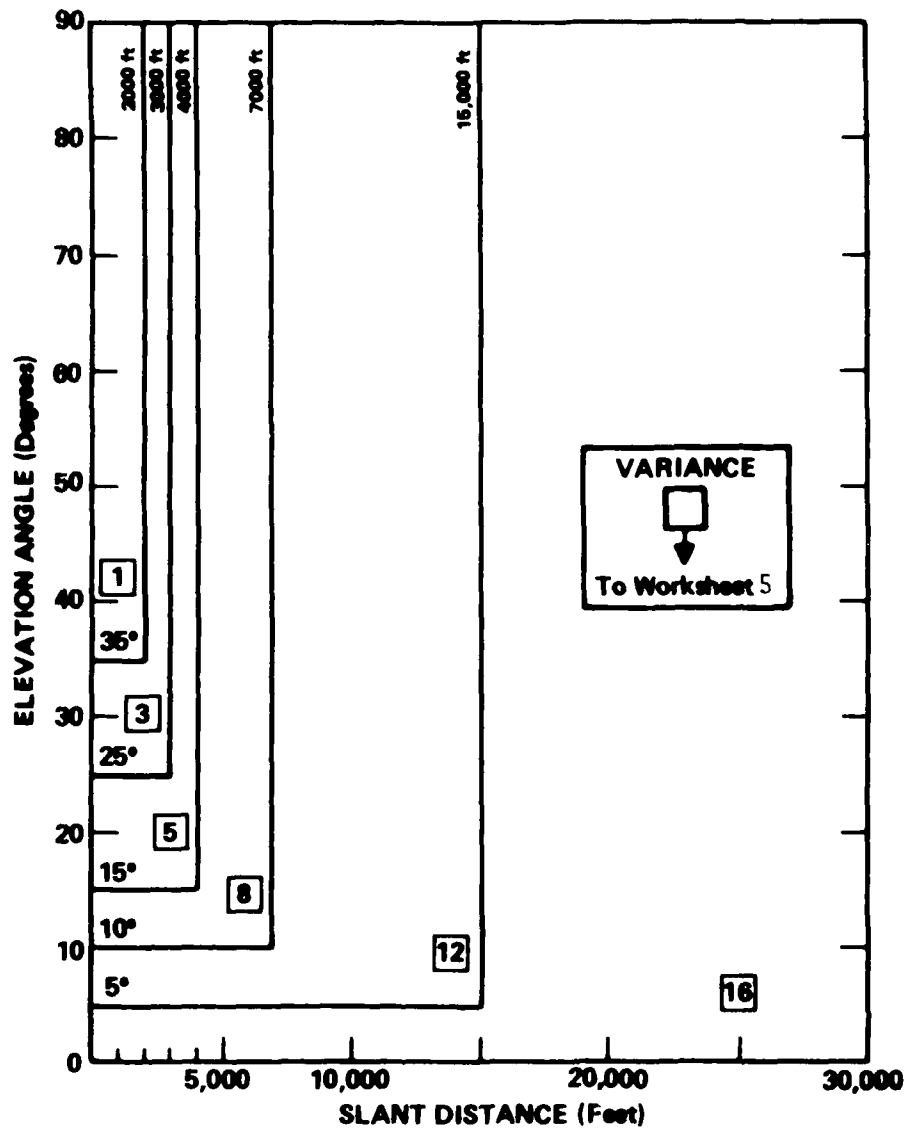


FIG. D-6. ESTIMATE OF NOISEMAP VARIANCE.

WORKSHEET 6

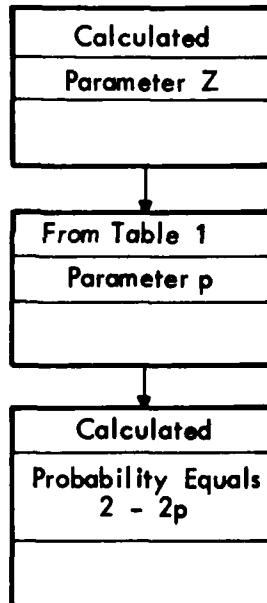
Measurement Program _____ Sheet _____ of _____

File Number _____

Engineer _____

Date _____

| From Worksheet or Worksheet | | From Worksheet | From NOISEMAP |
|--------------------------------|------------------|-----------------------------|---------------|
| Measurement Standard Deviation | Measurement DNL | NOISEMAP Standard Deviation | NOISEMAP DNL |
| σ_S or σ_M | DNL(M) or DNL(S) | σ_i | DNL(C) |
| | | | |



This Value is the Probability that the Measurements and the NOISEMAP Predictions are Consistent.

(The Probability that they are not Consistent is 1 Minus this Value.)

FIG. D-7. CALCULATE THE PROBABILITY THAT THE DNL FROM MEASUREMENTS AND THE DNL FROM NOISEMAP ARE CONSISTENT (WORKSHEET 6).

SUPPLEMENT TO WORKSHEET 6

For the measured DNL, denoted by DNL(M), that is computed from daily values of DNL (Worksheet 6), use:

$$1. \quad z = \frac{|\text{antilog}(\text{DNL}(C)/10) - \text{antilog}(\text{DNL}(M)/10)|}{\sqrt{\sigma_C^2 + \sigma_M^2}},$$

or for synthesized DNL, denoted by DNL(S), that is computed from measured SELs (Worksheet 3), use:

$$2. \quad z = \frac{|\text{antilog}(\text{DNL}(M)/10) - \text{antilog}(\text{DNL}(S)/10)|}{\sqrt{\sigma_C^2 + \sigma_S^2}}.$$

Measurement Program _____
 Sheet _____ of _____
 Engineer _____
 Date _____

[illegible][illegible]

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[illegible]

Use Eq. 1
in
Supple-
ment

[illegible]

Use on Worksheet 9 or for AIRCRAFT
SEL from NOISEFILE

FIG. D-9. CALCULATION OF SLANT DISTANCE AND AIRCRAFT SEL
AT SITES (WORKSHEET 8).

Supplement to Worksheet 8

1. Slant distance (ft) = $\sqrt{\text{perpendicular distance (ft)}^2 + \text{altitude (ft)}^2}$,

where the lateral distance is the perpendicular distance from the measurement site to the point of closest approach on the flight track.

2. Angle β in degrees = $\sin^{-1} \left(\frac{\text{altitude}}{\text{slant distance}} \right)$.

Measurement Program _____ Sheet _____ of _____

Engineer _____

Date _____

[illegible]

Use
Equations
in
Supple-
ment

[illegible]

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Supplement to Worksheet 9

$$1. \text{ Effective number of operations} = \left(\begin{array}{c} \text{number of day} \\ \text{operations} \\ (0700-2200) \end{array} \right) + 10 \left(\begin{array}{c} \text{number of night} \\ \text{operations} \\ (2200-0700) \end{array} \right).$$

$$2. \text{ Partial DNL - Aircraft SEL} + 10 \log \left(\begin{array}{c} \text{Effective} \\ \text{number of} \\ \text{operations} \end{array} \right) - 49.4.$$

$$3. \text{ Total DNL through rank} = 10 \log \left[\left(\begin{array}{c} \text{DNL}_1/10 \\ 10 \end{array} \right) + \dots + \left(\begin{array}{c} \text{DNL}_n/10 \\ 10 \end{array} \right) \right],$$

where n is the rank number being calculated.

TABLE D-1
THE RELATIONSHIP OF PARAMETERS p AND z .

| $z_p \rightarrow$ | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| .0 | .5000 | .5040 | .5080 | .5120 | .5160 | .5199 | .5239 | .5279 | .5319 | .5359 |
| .1 | .5398 | .5438 | .5478 | .5517 | .5557 | .5596 | .5636 | .5675 | .5714 | .5753 |
| .2 | .5793 | .5832 | .5871 | .5910 | .5948 | .5987 | .6026 | .6064 | .6103 | .6141 |
| .3 | .6179 | .6217 | .6255 | .6293 | .6331 | .6368 | .6406 | .6443 | .6480 | .6517 |
| .4 | .6554 | .6591 | .6628 | .6664 | .6700 | .6736 | .6772 | .6808 | .6844 | .6879 |
| .5 | .6915 | .6950 | .6985 | .7019 | .7054 | .7088 | .7123 | .7157 | .7190 | .7224 |
| .6 | .7257 | .7291 | .7324 | .7357 | .7389 | .7422 | .7454 | .7486 | .7517 | .7549 |
| .7 | .7580 | .7611 | .7642 | .7673 | .7704 | .7734 | .7764 | .7794 | .7823 | .7852 |
| .8 | .7881 | .7910 | .7939 | .7967 | .7995 | .8023 | .8051 | .8078 | .8106 | .8133 |
| .9 | .8159 | .8186 | .8212 | .8238 | .8264 | .8289 | .8315 | .8340 | .8365 | .8389 |
| 1.0 | .8413 | .8438 | .8461 | .8485 | .8508 | .8531 | .8554 | .8577 | .8599 | .8621 |
| 1.1 | .8643 | .8665 | .8686 | .8708 | .8729 | .8749 | .8770 | .8790 | .8810 | .8830 |
| 1.2 | .8849 | .8869 | .8888 | .8907 | .8925 | .8944 | .8962 | .8980 | .8997 | .9015 |
| 1.3 | .9032 | .9049 | .9066 | .9082 | .9099 | .9115 | .9131 | .9147 | .9162 | .9177 |
| 1.4 | .9192 | .9207 | .9222 | .9236 | .9251 | .9265 | .9279 | .9292 | .9306 | .9319 |
| 1.5 | .9332 | .9345 | .9357 | .9370 | .9382 | .9394 | .9406 | .9418 | .9429 | .9441 |
| 1.6 | .9452 | .9463 | .9474 | .9484 | .9495 | .9505 | .9515 | .9525 | .9535 | .9545 |
| 1.7 | .9554 | .9564 | .9573 | .9582 | .9591 | .9599 | .9608 | .9616 | .9625 | .9633 |
| 1.8 | .9641 | .9649 | .9656 | .9664 | .9671 | .9678 | .9686 | .9693 | .9699 | .9706 |
| 1.9 | .9713 | .9719 | .9726 | .9732 | .9738 | .9744 | .9750 | .9756 | .9761 | .9767 |
| 2.0 | .9772 | .9778 | .9783 | .9788 | .9793 | .9798 | .9803 | .9808 | .9812 | .9817 |
| 2.1 | .9821 | .9826 | .9830 | .9834 | .9838 | .9842 | .9846 | .9850 | .9854 | .9857 |
| 2.2 | .9861 | .9864 | .9868 | .9871 | .9875 | .9878 | .9881 | .9884 | .9887 | .9890 |
| 2.3 | .9893 | .9896 | .9898 | .9901 | .9904 | .9906 | .9909 | .9911 | .9913 | .9916 |
| 2.4 | .9918 | .9920 | .9922 | .9925 | .9927 | .9929 | .9931 | .9932 | .9934 | .9936 |
| 2.5 | .9938 | .9940 | .9941 | .9943 | .9945 | .9946 | .9948 | .9949 | .9951 | .9952 |
| 2.6 | .9953 | .9955 | .9956 | .9957 | .9959 | .9960 | .9961 | .9962 | .9963 | .9964 |
| 2.7 | .9965 | .9966 | .9967 | .9968 | .9969 | .9970 | .9971 | .9972 | .9973 | .9974 |
| 2.8 | .9974 | .9975 | .9976 | .9977 | .9977 | .9978 | .9979 | .9979 | .9980 | .9981 |
| 2.9 | .9981 | .9982 | .9982 | .9983 | .9984 | .9984 | .9985 | .9985 | .9986 | .9986 |
| 3.0 | .9987 | .9987 | .9987 | .9988 | .9988 | .9989 | .9989 | .9989 | .9990 | .9990 |
| 3.1 | .9990 | .9991 | .9991 | .9991 | .9992 | .9992 | .9992 | .9992 | .9993 | .9993 |
| 3.2 | .9993 | .9993 | .9994 | .9994 | .9994 | .9994 | .9994 | .9995 | .9995 | .9995 |
| 3.3 | .9995 | .9995 | .9995 | .9996 | .9996 | .9996 | .9996 | .9996 | .9996 | .9997 |
| 3.4 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9998 |

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